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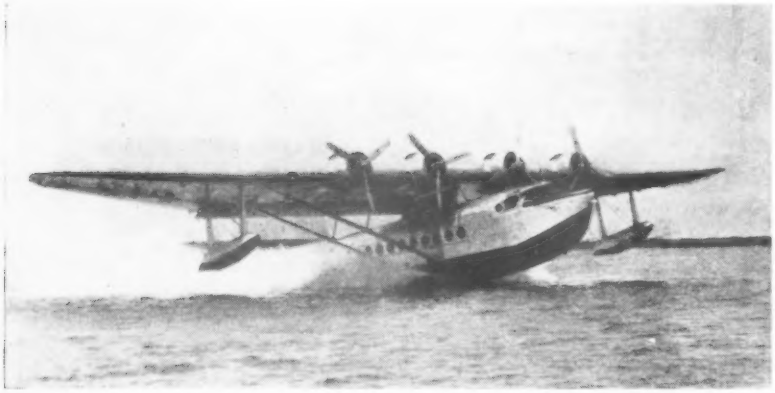
Will America Wing Over



The second ship of the S-42 series, the Pan American Clipper which will be used in Trans-Pacific experimental flights which Pan American plans to undertake.

by
E. STANTON BROWN

Commercial airlines editor for
POPULAR AVIATION.

DURING the first part of April, perhaps while you are reading this, the second of the giant Sikorsky S-42 flying boats, christened "Pan American Clipper," will skim the waters of the Bay of San Francisco under the mighty drive of her four 700 h.p. supercharged Pratt and Whitney Hornets.

As she shakes the last streaming drops from her glistening hull, "Pan American Clipper" will soar over the Golden Gate. There will be a moment's lull in the clamor of the motors while the controllable propellers are shifted into cruising pitch. Then, hull down on the southwestern horizon, the first trans-oceanic commercial flying boat will roar into the limitless expanse of sea and sky, toward the palm-clad shores of Hawaii.

The invisible tracks of the radio beacon will hold her true to course, straight as an arrow, for the minute isles, 2,091 miles away. The first experimental flight of Pan American Airways' trans-Pacific service will be under way. Beyond Hawaii lies Midway Island, smaller yet, the next port of call for the proposed service, and 1,300 miles further on. The next hop will be one of 1,100 miles to Wake Island, and then 1,500 miles to Guam. Between Guam and the city of Manila, in the Philippine Islands, Pan American Airways' flying Clippers will soar 1,501 miles. The last leg, from Manila to Canton, China, will be child's play by comparison, a hop of 640 miles across the northern end of the South China Sea.

A journey of 20 days by the best of steamers, will have been shortened to 70 hours, drawing the Occident and Orient closer together, commercially, physically, psychologically, toward greater understanding and mutual benefit.

Behind the first take-off, lies years of careful preparation, far-sighted planning and intensive training. The construction of the ships was begun in 1932, after the Sikorsky Aircraft Corporation and the Glenn L. Martin Company had contracted to build them to meet the severe specifications. Bonds were posted to insure that the ships would be capable of meeting the specifications and providing the performance demanded. There was to be not the slightest hitch in the plans if Pan American could help it. The results have been gratifying. Both plants went a step further and slightly exceeded the specifications.

The way has been paved in China by developing jointly with the Chinese Government the China National Aviation Corporation, an extensive air transport system of some 3,000 miles. The trans-Pacific Clipper Ships will connect at Canton with China National planes flying up the coast 1,759 miles to Peiping via Shanghai. From Shanghai an arm extends westward 1,226 miles to the city of Chengtu. In such a manner will the most important commercial centers of China be served direct from the coast of California with the most modern and efficient of air transport equipment.

It is characteristic of Pan American Airways that proper transportational and terminal facilities have been developed in China before the trans-Pacific service has been inaugurated, thus insuring the all-important traffic channels for the flow of air commerce and passenger traffic.

More than 5,000 miles of practice operation has been logged on "Pan American Clipper" over a 1,200-mile route between Miami and Puerto Rico. The first run over the practice route was made by daylight, and the return flight was made at night, entirely over the open sea beyond the sight of any marine lights or landmarks. Cruising speed was not a consideration on either of these long-range flights. Nevertheless, the Clipper Ship covered the distance in each direction in less than 8½ hours, using but 62.5 percent of the available 2,800 h.p. A stretch of the flight 300 miles long was flown blind

Front elevation of the Martin Clipper Ship showing its clean lines and the disposition of the four engines. The elevator is larger than the main planes of many ships.

the North Pacific Ocean?

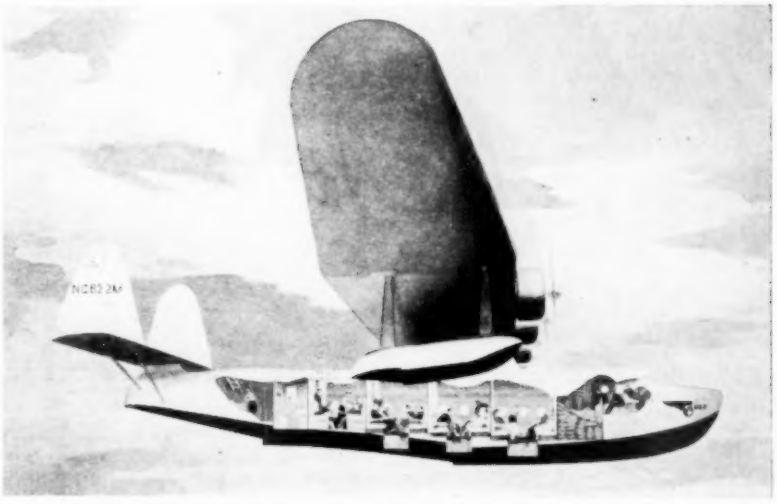
through a cloud strata by the use of instruments alone.

After nearly three years of classroom studies, during which "paper" flights were navigated on scheduled runs over both Pacific and Atlantic routes, Pan American marine pilots and other personnel had their first opportunity of putting into actual practice on this flight the long-range flight operation knowledge gained over these three years.

During the preliminary training period, the big cockpit, which has stations for pilot, co-pilot, radio operator and flight engineer, was divided. One-half was hooded over so that the pilots had no visibility beyond the instrument board. They were required to fly blind, using only the instruments to keep them on flight course and at various altitudes specified by the operations official in charge. A complete series of graduated load, speed and altitude tests were run. Night landing and take-offs and operation of the ship in all types of weather served to further train the crew.

In addition to the personnel training, the preliminary flight tests were run to test and collect data on the operation of new instruments and mechanical aids, most of which were specially designed for use on the trans-Pacific route. A special pumping system was devised to convey the fuel from the 1,320-gallon cabin tanks into the wing tanks, which have a capacity for an additional 1,270 gallons. Tanks have also been installed to carry more than a half a ton of oil.

The Pratt and Whitney people perfected a new device for the forced lubrication of rocker arms and other lubrication during flight which before had been lubricated on the ground. This system will be in use on both the Hornets used on the Sikorsky Clipper Ships and the twin-row 800 h.p. Wasps on the Martin Clipper Ships.



A phantom view of the "Brazilian Clipper," a sister-ship to the "Pan American Clipper," showing interior arrangements. This ship is now in service between Miami and Buenos Aires.

An electrical device by which the four engines can be synchronized perfectly was developed by Pan American engineers. A new meter which measures the rate of flow of gasoline into the carbureters is another important instrument for the ships.

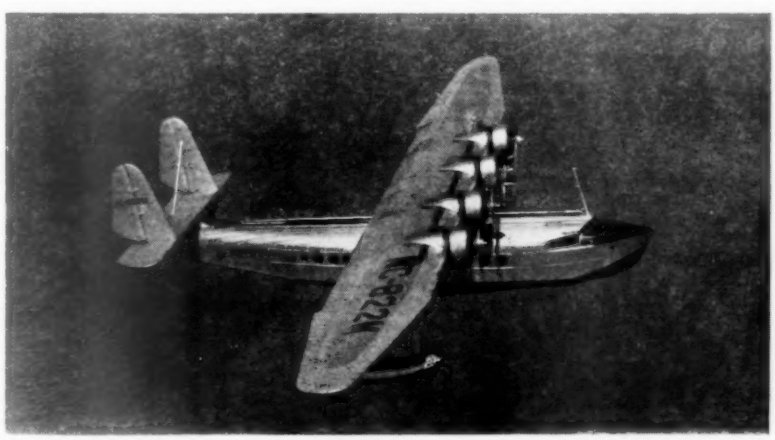
Advanced type two-way radio apparatus, also developed by Pan American engineers from their highly successful transport radio equipment, is being installed together with a Goniometer, a new direction-finding system which the airline engineers have developed in their laboratory during the past year. New and advanced types of sextants and octants, together with a special drift indicator to measure surface speed over water, are also included in the navigational equipment.

Celestial navigation and dead reckoning were used by the pilots for navigating flights, while radio direction finders covered the entire flight to form a check on the pilot's navigation. The variation between celestial navigation sights and radio bearings showed a differential of less than one-tenth of one percent. At the present writing a second series of flight tests are under way, taking the ship up to its full range limit of 3,000 miles. When these have been completed, Pan American Clipper will be flown to the Pacific Coast.

A crew list that will undoubtedly be followed for the trans-Pacific operations was carried on all training flights. This consisted of a master pilot, a second officer pilot, a third officer pilot, a navigation officer, an engineering officer and a radio officer. In addition to this regular training crew, two motor specialists were carried on the initial flights to supervise fuel consumption tests and the operation of auxiliary engine instruments installed for experimental purposes.

Extensive ground and meteorological surveys and studies of terminal facilities have been completed. The San Francisco terminal facilities are now under construction at Alamada Airport, across the Bay from San Francisco. It is being provided with the necessary marine facilities for use as a temporary operating base on the California Coast. An opening is being made in the breakwater to provide necessary clearance for the Martin ship, "Clipper Pioneer," when it comes into use.

A ramp is being constructed on which the ships can be taken in and



The "Brazilian Clipper" in flight. It weighs 19 tons and has a wing-span of 114 feet. Carrying capacity is 32 passengers.

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out of the water. A smooth surfaced runway will be laid down from the ramp to one of the main hangars at the airport, which will be enlarged and improved to accommodate the giant flying boats. A traffic office is being opened in San Francisco. K. A. Kennedy, formerly General Traffic Manager of United Air Lines, has been named Acting Division Traffic Manager, Pacific Division.

Radio stations are under construction at each of the points across the Pacific. Pan American engineers have developed a new radio beacon which far outstrips any yet built. On our domestic airways, the range of the beacons is but 150 miles. The new Pan American beacon has a range of 1,800 miles, which provides a wide margin of overlap on even the longest hop, the San Francisco-Hawaii leg.

After the first experimental flights have been completed, mail will be carried. It will probably be six months before passengers are carried over the new route. When passenger service is inaugurated, the Martin Clipper Ships will, for the most part, operate over the route's longest hop from San Francisco to Hawaii. The Martin, nearly a third larger than the Sikorsky S-42, will be able to negotiate the 2,091-mile hop carrying twenty-four passengers and a ton of mail and express. Over the same route the Sikorsky could carry approximately ten to fourteen passengers. Consequently, the S-42's will undoubtedly be used on the shorter legs of the route over which their pay load will be greater.

When the Sikorsky and Martin plants complete the orders now on hand, Pan American Airways will have a fleet of ten of the giant Clipper Ships. It is intensely interesting to mark the growth and expansion of Pan American Airways in the seven years of its existence. Starting in 1928 with a fleet of seven planes and operating over but 251 miles of route mileage, Pan American at the end of 1934 was operating a fleet of 139 planes over 32,552 miles of air routes. In 1928 the personnel numbered 118. Now 2,801 employes are on the pay roll. The first year of operation saw the completion of 297,000 passenger miles flown and 270.155 pounds of mail and express were carried. In 1934, passenger miles numbered 35,000,000 and 1,884,000 pounds of mail and express were carried.

With the inauguration of the trans-Pacific service this year, route mileage will be increased by 8,000 miles and one of the most vital and important steps in the history of air transportation will have been taken. Not since Lindbergh flew the Atlantic has an aeronautical event borne such weight and significance as will the inauguration of the route to the Orient.

It is the culmination of the dreams and hopes of aviation men for years and will even influence the man in the

(Concluded on page 331)

Aviation Notables Have Meeting

Here are your air heroes all dressed up. Know them?

MANY of America's outstanding pilots and aeronautic celebrities gathered at a banquet recently held in their honor at Washington, D. C. Senator McAdoo presented diplomas to the most distinguished pilots of 1934 in the name of the National Aeronautic Association.

From left to right, in the group shown, are Col. Eddie Rickenbacker, American War ace; Capt. Boris Sergievsky, holder of numerous flying-boat records; Clyde Pangborn, who with Roscoe Turner, finished third in the London to Melbourne race; Helen McCloskey, who broke the women's world speed record; and last, but not least, is Jimmie Doolittle, who recently established a West-to-East transcontinental speed record of 11 hours 55 minutes. Their records are now official records via F.A.I.

Radio Equipment in Bombing Planes

THIS photograph shows the radio equipment installed in the U.S. Army Air Corps bombers, with Lieut. Marvin L. Harding, radio operator, at the dials.

This particular equipment was installed in one of the twenty-nine bombers that made the 1,100-mile overwater hop from Panama to Washington, D. C. The ships are Martin B-12A planes, familiar to many of our readers.

Recent developments in "two-way" aircraft radio have made tremendously long range communications possible between planes or between the planes and the ground stations. A few years ago, a plane could only transmit a few miles but now, signals reach out in thousands of miles.

Lieut. Harding listening-in on the bomber radio.

The Test Pilot and His Job

by LIEUT. H. LATANE LEWIS, II

Describing the thrills and dangers that attend the flying tests of brand-new planes that have never before taken to the air.

TEST pilot! Those two words have a glamorous sound, even in these days of careful planning and equally careful building of new types of aircraft, as opposed to the old "hit or miss" system which so often resulted in death for the men who test-flew the resulting airplanes — more often than not without a parachute.

In the Army Air Corps, nothing about a new type of airplane, no matter whose factory it comes from, is taken for granted. Army airplanes must stand much more severe punishment than is ordinarily required of commercial ships. Constant exposure to all sorts of weather, coupled with the rigorous straining combat flying necessary in military aviation, makes it absolutely imperative that each new type of airplane be thoroughly tested.

The test pilots at Wright Field take nothing for granted. Wright Field, Dayton, Ohio, might be termed the heart of the aviation industry—both military and commercial, which are, after all, closely akin—for here is where most of the new developments, a great many of the newest inventions are brought forth for the benefit of American pilots—for those of the whole world, for that matter. The new instrument landing system of the Department of Commerce was developed at Wright Field, by Captain Albert Hegenberger, famed for his and Lt. Lester Maitland's flight from the United States to Hawaii several years ago.

Often officers of the flying branch at Wright Field, whose job is test-flying the airplanes offered for sale to the Army, take a ship into the air, put it through the most gruelling maneuvers, and bring it down safely. Then, very frequently, the airplane will fail, necessitating the pilot's bailing out, or fighting the disabled ship to a safe landing.

Take, for instance, the case of captain, then lieutentant, Harrison G. Crocker, a veteran flyer, then a member of the flying branch, and now a student in the Air Corps Engineering school, at Wright Field:

Captain Crocker took off one bright October afternoon, several years ago, in a new, two-place pursuit monoplane. He flew for some time, lazily circling around over Dayton. Then he decided to come in and land, only to discover that the retractable larding-gear of the experimental airplane was jammed! One wheel was stuck tight in a position half-way up and half-way down, and the other dangled loosely on its support! What could he do? The airplane was new, untried—he had no idea of how it would hold up under the strain of that sort of a landing.

Captain Crocker circled around and around over the field, desperately working to lower the gear, and snap the wheels into position. The average pilot, it might be added at this point, would rather bring his disabled airplane down, and risk a dangerous crash, than jump, and have to depend upon a parachute, unless, of course, the airplane is completely out of control. The idea is, the pilot has more faith in his ability to land the shattered ship than he has in a piece of silk! Such was Captain Crocker's idea; he was going to land that ship, wheels or no wheels!

WHEN a brand-new plane from the factory first takes to the air, almost anything can happen on its maiden flight. Someone may have left a few spare monkey wrenches in the cockpit, another workman may have forgotten to safety an important nut and bolt and so on through a thousand different items that may have been incorrectly assembled.

And it is the test pilot that risks his neck to discover these faults before the ship is taken over by the regular pilot. He dives it, rolls it and takes it through all the capers that will be expected later, just to find out whether it will hold together or whether its performance is according to specifications.

In the meantime, the ground force had discovered his predicament. Hastily, chalk was brought, and on the side of another airplane were written the words, "Wheels half down." The airplane took off, and flew up alongside Crocker, to let him know exactly what his chances were.

Crocker immediately threw his ship into violent maneuvers. He spun, looped, dived, and snap-rolled the airplane, in a desperate attempt to force the jammed wheels into position. It was to no avail, they were firmly caught, and nothing he could do would release them.

Then he decided to land anyway, hoping that the ship would slide along on its belly, without seriously damaging itself or him. However, as he came slowly in to land, he was waved off. So he climbed again, waiting for the O.K. signal.

In the meantime, the commanding officer of the field, and chief of the material division of the air corps, General H. Conger Pratt, now chief of the Atlantic wing of the air corps' new General Headquarters air force, had been informed, and had arrived on the scene. Taking in the situation at a glance, and hastily conferring with the other officers who were standing in a group in front of the operations office, he ordered that another ship, bearing the chalked words, "General says jump at F.A.D." be sent aloft.

"F.A.D." stands for Fairfield Air Depot, the air corps supply base at Patterson Field, just a few miles from Wright Field. Patterson Field is an immense reservation, about four miles long and two miles wide. General Pratt felt that it would be better for Captain Crocker to abandon his ship there, where there was very little chance of it hitting anyone on the ground, than for him to jump at Wright Field, which isn't so large, and is only about two miles from Dayton.

The general was of the opinion that it was better to have Crocker make the jump, and "wash out" the experimental airplane, which could be replaced, despite its cost, than risk the life of Crocker, a valuable officer who *could not* be replaced.

The second ship took off, and flew alongside Crocker, in his disabled pursuit ship, so that he might read the message. These were orders from the general, and he could not disobey them. Regardless of his personal opinions, the sense of duty which had been instilled in him forced him to carry out his orders. So, he circled, and headed for Patterson Field. The writer, and others on the ground, jumped in automobiles and drove at sixty miles per hour for the scene of the prospective jump.

Captain Crocker arrived over the field, and prepared to bail out. Evidently having a last minute change of heart, he climbed thousands of feet, and hurtled the airplane into a power dive, perhaps hoping that one of the gods of the air would force the wheels

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into their normal position. His efforts were fruitless, so he leveled off at 4,000 feet and climbed out. As he was almost over the edge of the cockpit, the ariplane lurched, and circled away toward the biuldings on the field. Crocker climbed back in and straightened the ship out, then dived over the side!

He plummeted toward the ground, his parachute boomed open, and he slowly drifted to a safe landing on the earth, suffering no more damage than, in his own words, " a couple of banged-up fingers!" An hour later he was back at his desk again, hard at work.

After the pilot abandoned the airplane, it made two long, lazy circles, all the time slowly losing altitude. Once it headed straight for the crowd, among whom was the writer. All of them madly scattered, although it was thousands of feet away, but it finally swung off in another direction, much to the relief of everyone.

Traveling at least two hundred miles per hour, the ship struck the field on one wing-tip, leaping into the air in a cloud of dust, to strike again a few hundred feet further on, and coasted to a stop. The ship was a mass of wreckage; the wing was splintered into fragments no bigger than a shingle, and the engine was buried deep in the ground. The front cockpit was a tangled mass of metal, but the rear cockpit was undamaged, and, most surprising of all, the clock was still merrily ticking away!

Such incidents as these are merely something a little out of the ordinary to most of the Wright Field pilots; witness Captain Crocker going back to his desk to finish his day's work. Just a few months before this accident, Captain Crocker brought down and safely landed a ship in flames. He thought nothing of it. A few years before that, he landed a disabled airplane after the passenger, frightened, jumped to his death.

Sometimes, however, the accidents do not end so happily, and then a flight of ships fly over the Union Station in Dayton, dropping flowers on the train carrying the casket containing the battered body of a young officer to his last resting place.

Two years ago, on a Friday the 13th, Captain Frank O'D. Hunter, World War ace, and Captain Hugh Elmendorf spun three thousand feet to crash in a wooded hollow a few miles from Wright Field. The cause of the spin of the new attack plane was never ascertained. Captain Hunter jumped when but a few hundred feet from the ground, and escaped death by a narrow margin. Captain Elmendorf was killed instantly. His mangled body was unrecognizable.

The following Sunday, Lt. Irvin Woodring, also of Wright Field, and last man of the air corps' famed stunt group, "The Three Musketeers," accompanied Captain Elmendorf's shattered body on its last ride, to Washington, D. C., where he was buried in Arlington cemetery. A week later, an-

(Concluded on page 327)

Giant French Airliner in New Test

The "Lieutenant de Vaisseau" taking off. This ship accommodates 84 passengers.

SOME TIME ago, we published a picture of the giant French airliner, "Lieutenant de Vaisseau" under construction. Since that time, many flight tests have been conducted and it is now ready for its scheduled flights between Landes, France, to South America, over the South Atlantic Ocean.

It is said to be the most luxurious commercial plane yet constructed and rivals the modern ocean liner in its appointments and conveniences. It is double-decked with running water and baths in each stateroom. It has accommodations for 84 passengers, weighs 37 tons and can carry 19 tons payload in the form of passengers and cargo. Its top speed is 140 m.p.h.

Another view of the giant French airliner giving an idea of its tremendous size.

The Savoia-Marchetti S.80 Amphibian

THIS is a light amphibian with a disappearing under-carriage, intended for the private owner. It is built by the Savoia-Marchetti Company.

The monoplane cantilever wing is waterproof and made into water-tight compartments that will support the machine for long periods should the machine make a forced landing on water. The hull is a double-planked bottom wood construction, copper riveted and water-proofed by the insertion of mastic and fabric. It is driven by a Colombo S.63 six-cylinder in-line engine provided with a metal propeller.

The span is 36'-0" and the length is 25'-6½". The maximum useful load is 880 pounds with a total weight of 2,420 pounds. It has a maximum speed of 136 m.p.h. and climbs to 3,000 feet in four minutes, 18 seconds. The service ceiling is 35,000 feet.

We believe that this type of plane, an amphibian, will prove one of the most popular types of sport-craft in the future.

The S.80 Savoia-Marchetti amphibian drawn up on the ramp. It has unusually clean lines for an amphibian.

An Amazing Air Freight Cargo

by E. W. SUDLOW

How the Pan American-Grace lines transported tons of mining machinery across the Andes mountains with total flying time of 425 hours for the job.

IT is not so very many years ago that the average person looked with awe upon the airplane carrying a sack of mail. It seemed almost impossible that the heavy mail sack could be made to travel through the air.

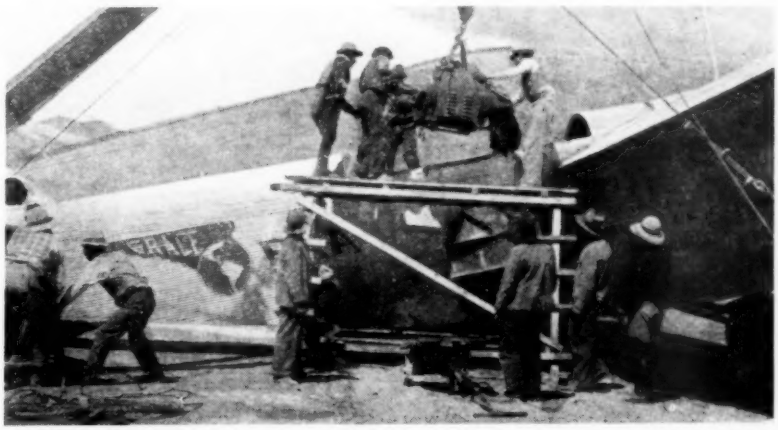
Today, we have regular air-express shipments being made daily and now a report of transporting of 735 tons of mining machinery by plane across the Andes. How this most amazing freight contract was fulfilled by airplane is as marvelous as any fairy tale. The flight commenced August, 1934, and the total flying time was 425 hours.

As Pan American-Grace Airways tells the story, it was this way: "High up in the very heart of the Andes, a three hours' flight southeast of Lima, Peru, is an old gold mine, the Cochasayhuas, known and producing since the days of the Incas. During the last few years the exploitation of the mine had not proved profitable although the possibilities were known to exist. In 1932 the mine was taken over by a group of Peruvian capitalists under the name of Cia. Explotadora Cotabambas, S. A., who realized that the fullest development of the property required the most modern machinery.

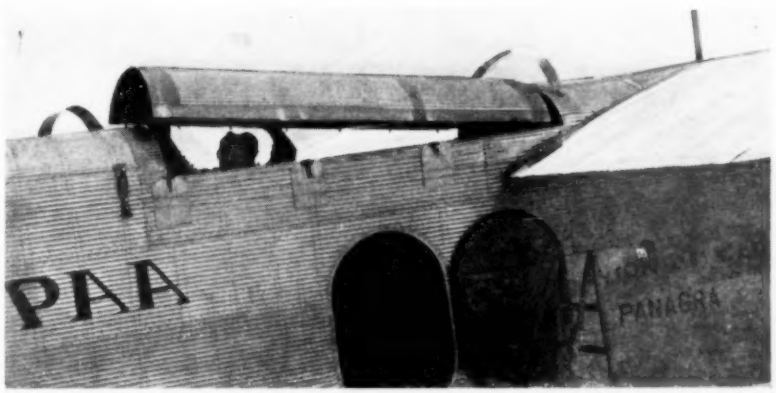
The problem was to get the machinery to the mine. From Cuzco (10,900 feet) to the mine site (12,500 feet) a distance of 36 miles, the trip on mule back required ten days to three weeks. The trail was narrow, difficult and dangerous because of intervening mountains. The transportation of large pieces of machinery was practically impossible under these conditions and the cost of building a road was prohibitive.

In June, 1933, the Pan American-Grace Airways, Inc., transported 55 tons of mining machinery to the mine, proving that the most economical way to move the necessary equipment was by air. When the expansion of operations required additional plant capacity again, the owners called on Panagra to transport an additional 660 tons of still heavier machinery. Actually 740 tons were transported.

The transportation of 740 tons of mining machinery by air is in itself an unusual achievement for any aviation company. The conditions under which this aerial freighting on a large scale was successfully accomplished make it even more unusual. Landings and take-offs at these altitudes are much faster than at sea-level and require piloting of the highest order. Flying conditions are not always ideal,



Unloading the plane at Huanacopampa, the load lifted in this view being a good big husky electric motor. This is another testimonial to the old reliable Ford tri-motor plane, lately discarded on several American airlines.



Showing the arrangement of the hatch at the top of the fuselage through which the larger pieces of freight were lifted by a crane. This must have introduced some extensive changes into the framing of the fuselage.

Some specimens of the mining machinery at Cuzco, awaiting transportation to the mines by plane. Everything from crusher rolls and flywheels down to bolts and nuts are assembled in this lineup.

high winds and other atmospheric disturbances are prevalent.

The airport at Cuzco lies at an altitude of 10,900 feet. The runway (50 feet wide and 4,400 feet long) during the season is used as the municipal race track. About 35 minutes flying is required between Cuzco and Huanacopampa over a mountain range 15,000 feet high. Once over the range the plane descends to the airport at Huanacopampa which is located on a plateau above the Apurimac valley. The runway is 12,800 feet above sea-level.

At 10:55 A. M., August 3, 1934, the Pan American-Grace Airways, Inc., multi-motored Ford plane, "San Fernando," left the company base at Lima, Peru, bound for Cuzco, Peru, the ancient capital of the Incas. This plane, similar in every respect to the passenger planes used for the international air service of this company, had been converted to a cargo plane.

All the interior fittings of the cabin had been removed. A hatch was opened in the top of the fuselage some 9½ feet long by 4 feet wide. The windows with the exception of one on each side were blocked with smooth sheet dural. A small car operated by a cable winch and riding on rails fore and aft was installed in the cabin to properly trim the load. The motor plant comprised two 550 h.p. supercharged Wasps outboard and a 450 h.p. supercharged Wasp in the nose.

The plane was equipped with the standard two-way P.A.A. System radio apparatus which rendered the customary satisfactory communication between plane and ground. The first personnel detailed to this special work was: First pilot, T. F. Jardine; radio man, C. N. Pursley; senior mechanic, R. Ewing; junior mechanics, M. Vargas and J. Sosa.

Pilot Jardine had been in charge of the aerial freighting the previous year and was thoroughly familiar with the terrain and procedure.

This year, the transportation involved a complete milling, amalgamating and cyaniding gold plant to treat 150 tons of ore every 24 hours, an addition to the hydro-electric plant to develop 750 extra h.p. and a large quantity of miscellaneous machinery, equipment and construction materials. The electrical plant was manufactured by the Westinghouse Company, the crushing, milling and amalgamating plant by Fraser and Chalmers, and the cyaniding plant by Merrill Crowe. The first phase of the work consisted in flying one by one a battery of 26 Fraser and Chalmers mortars for the milling plant, each weighing approximately 2 tons.

Loading of the plane was accomplished by a boom and ginpole with double hand winches, manned by local Quechua Indians under supervision of a Peruvian foreman. The load was hung from the crane until the plane could be rolled into position with the hatch directly underneath. Then the load would be lowered onto the trolley in the plane and hauled forward. At Huanacopampa this same procedure was followed in inverse order.

A more modern bi-motor monoplane operated by Pan American.

Actual freighting began on August 14, 1934, with two flights. In the course of the next 13 days an average of 4 flights per day were made. 175,659 pounds, including all the large pieces had been transported in 45 flights. In expectation of speeding up the work with additional planes, Pilot F. Sterling arrived in Cuzco at this time to become familiar with the terrain and operating methods.

The Indians in the territory around Cuzco and Huanacopampa never ceased to marvel at the wonderful performance of the great mechanical bird. It is said that some of them walked 18 days for a sight of this miracle, coming from points as far away as Puno on the shores of Lake Titicaca.

Pilot Jardine, the day before his departure, was given a "fiesta," by the Indians dressed in their native costumes who danced and sang for their distinguished guest. At the end of the ceremony they showered gifts upon Pilot Jardine, consisting of coca, coca pouches, slings, ponchos, pottery and all food necessary for a long journey, including a live black ram which was brought back to Lima on the plane. All present at the "fiesta" were regaled with many different dishes of native food.

Work was resumed on August 22nd with Pilot Sterling in charge after the plane had made a trip to Lima base for the periodic inspection. Rapid progress was made, as on several days 6 flights were completed. On September 18th, seven round trips (25,500 pounds) were flown, a record for one plane which stood for the term of the contract.

Radio communication played an important part in this freight flying job, especially in supplying meteorological information and keeping the head office in Lima, Peru, advised of the progress of the work. Because of the rapidly changing weather conditions, meteorological information is essential to a pilot flying in this sector. For this purpose Panagra equipped ground radio stations were installed at Huanacopampa and at Cuzco.

These stations, keeping constantly in touch, were able to advise the pilot at all times of the weather conditions to be found crossing the mountain range. These stations were manned by Panagra radio operators, C. N. Pursley and W. C. Brown, who were especially detailed to these posts.

On September 8, 1934, the "San Fernando" returned to Lima for its second periodic inspection and overhaul. The freighting was resumed from Cuzco on September 15, 1934. Up to that date 245 tons had been moved—a notable achievement in itself, already surpassing by more than 4 times the tonnage moved the previous year.

An additional plane, Ford "San Felipe," piloted by B. Rickards, was assigned to the work and arrived in Cuzco on September 24, 1934. No extensive alterations were made in the San Felipe except to remove the interior cabin accommodations as it was intended to carry only the smaller pieces which could be loaded through the door. The half way point was reached on September 26, 1934, with a total of 370 tons safely landed at Huanacopampa.

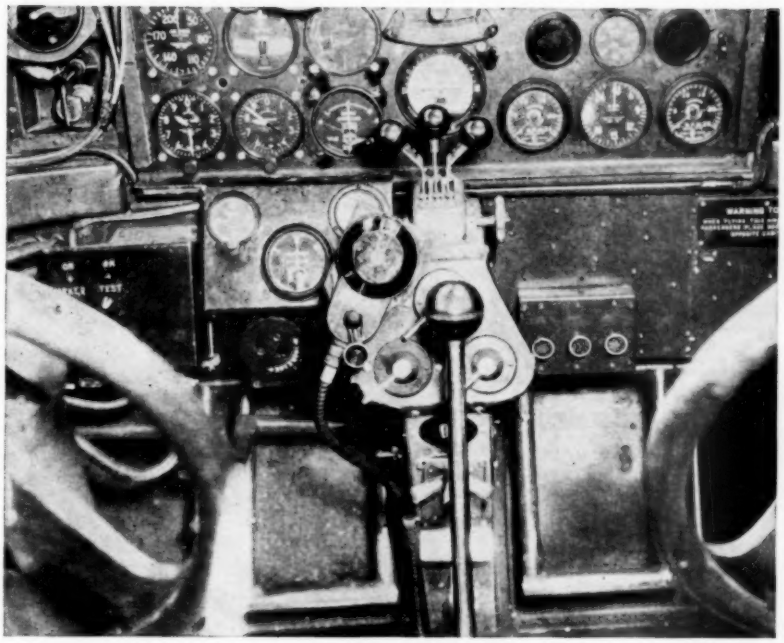
The swift shuttle of the great freight planes between Cuzco and Huanacopampa continued without interruption except for occasional adverse weather. The piles of machinery and materials waiting their turn on the Cuzco field became smaller and smaller, while at Huanacopampa engineers were busy installing the equipment which had already arrived. This activity continued until 740 tons avoirdupois were moved.

On October 31, 1934, at 3:30 in the afternoon both the "San Fernando" and "San Felipe" landed at Cuzco completing the 420th and 421st round trip flights, Pilot Sterling sending the laconic radio message:

"Last trip—cargo finished."

Blind Landings in the Army

by
MAX KARANT
Aviation editor of the Evanston News-Index.



Instrument board of blind landing plane.

EVER since the first sputtering man-carrying kite flew 32 years ago, airmen have fought constantly their worst enemy—weather. Far too many of their battles and their lives have been lost to the Great God Weather.

For more than two years the United States Bureau of Air Commerce and the Army Air Corps have been working quietly on and perfecting instruments that enable the foul-weather pilot not only to fly blind but also to make totally blind landings! The fruits of the labors of these two government agencies soon are to be installed on the Midcontinent Airway from New York to Los Angeles—the route now flown by United Air Lines. Major airports along the way are being prepared for the installation of two complete blind landing units each.

Once installed, these airports will be the scenes of the most exhaustive in-the-field tests ever to be attempted.

Of course, every exceptionally difficult problem, upon its solution, is surprisingly simple. Take, for example, the aircraft machine gun that is synchronized to fire between the blades of a propeller traveling anywhere from 1,600 to 3,000 revolutions per minute. That problem, on the face of it, would surely stump any inventor as it did the scores who tried to solve it during the first days of the World War. The closest they could come to it was the addition of metal tips to the props so that bullets striking the blades would bounce off harmlessly.

It remained for a young Dutch airman, "Tony" Fokker, to turn aerial warfare inside out simply by installing a small cam on the engine shaft which when released, would strike the trigger of the machine gun at just the right time so that every bullet fired passed between the blades. Simple—once you know how.

The antenna system of the landing device.

The blind landing problem was approached in much the same way. Seasoned pilots scoffed at the mere thought of landing an airplane at 70 miles an hour without even seeing the ground. Meanwhile, a small group of persistent pioneers headed by Capt. Albert Hegenberger of the Army Air Corps and Chester Snow, Jr., of the Bureau of Air Commerce, silently plodded ahead. Although it isn't generally known even today, this small group of pilots has made over 200 totally blind landings! One United States airline has been training its pilots secretly in the new art for the past six months. The result of this work has been an unquestionable success.

Undoubtedly you are interested in seeing just how these skilled airmen solved the blind landing problem—aviation's only means of overcoming her deadliest enemy, weather. Well, let's go for a flight in the government's tri-motored Ford with which the experiments have been conducted and see just what every air passenger will be taking for granted within a very short time.

So skeptics won't be able to say we made it easy for ourselves, let's take our flight in a pea soup fog. Our pilot can barely make out the dim arc of his

center engine propeller—and *that's all!* Inasmuch as this is primarily a blind landing demonstration, let us say we are 2,000 feet in the air and headed for Chicago's municipal airport which is equipped with two portable radio broadcasting units mounted on light motor trucks.

Each truck is a low power broadcasting station equipped with a gas-engine-driven generator for power supply and a collapsible mast antenna. While both operate on separate frequencies, each truck carries a small secondary transmitter that causes a light to flash on our ship's instrument panel as we pass over the unit. In operation, the two trucks are placed on a line which projects across the landing area in the direction along which we are to land. Generally, one of the two trucks is about two miles from the field, while the other is approximately a quarter of a mile from the edge of the airport.

Say we are thirty miles from Chicago and, using the two-way radio, our pilot has made the necessary preparations for our coming landing on a fog-hidden airport. The two trucks are in position and waiting for us.

Our pilot tunes his radio compass in on the inner truck. Should we happen to veer off our course, either to the left or right, the needle of the radio compass indicator on the instrument panel will flicker in that direction. A Sperry artificial horizon tells us that we are flying level and steady. Our two sensitive altimeters (one for checking the other) which can measure our altitude accurately within 150 feet, assure us that we are still at 2,000 feet.

Flying steadily toward the broadcasting unit on the inner truck at the airport, a light on our panel suddenly flashes the news that we have passed over it. Our pilot immediately tunes in on the outer transmitter and flies to it. Upon passing over it we turn and fly back to the first station, our pilot all the time adjusting his directional gyro which is the latest and most accurate aircraft compass.

We fly back and forth between the two ground stations a few times until our pilot has computed the accurate landing course on the directional gyro.

Now, approaching the airport for the landing, we use the sensitive altimeters to descend to 800 feet over the truck that is two miles from the field. Our pilot throttles the engines down to a power glide. We slowly lose altitude until, as we pass over the inner truck, we are 150 feet above the ground. Knowing that we now are headed right down the runway, our pilot, with his eyes glued to the artificial horizon, makes sure we are level. The fog is now so thick that it is almost dark and our range of vision only covers the lighted interior of the cabin.

As we lose more and more altitude our altimeters warn us that we are now gliding but a few feet above the runway. Slowly easing the wheel back our pilot "feels" the controls until we hear the sudden reassuring rumble of the wheels rolling on the field and—we're down! Simple, isn't it? And we can't see even the hangars 100 feet away!

The foregoing is by no means a brainstorm. It is an actual proved fact and has been done time and time again. It is thankful news to hear that this equipment soon will be installed not only at Chicago but at New York, Cleveland, Omaha, Cheyenne, Salt Lake City and Los Angeles. Once again the United States is about to show the rest of the aeronautical world "how to do it."

Probably, in the course of time, this invention will be expanded to the point where mountain peaks and other sharp high elevations of the ground will be equipped with similar radio signal systems that will warn a low flying plane of danger. Scattered at the proper points along an airway, the pilot would be warned of mountain peaks or high hills by apparatus very similar to that described here.

Radio control is rapidly working its way into aviation, performing safety signal service similar to that on the railroads.

The Bureau of Air Commerce now is conducting further blind flight and landing tests with a new Martin bomber which has been loaned by the Army. To assure itself that the system will be applicable to the latest high-speed aircraft, the Bureau also will rent a Douglas transport monoplane for a limited period. Results obtained with these two ships will be correlated to determine differences in approach and landing performance of the two types.

Yes, aviation's deadliest enemy is doomed. Blind flight operations at last have been perfected.

END

The tri-motor Ford with which landing experiments were made.

Well, Well, Well, Whaddye Think of This?

This outfit may seem freakish, but it does the work.

LET us introduce you to Olem Sohn, the well-known parachute jumper who is electrifying the inhabitants of the U.S.A. with his exhibitions of soaring and gliding. Equipped with his homemade wings, he bails out at about 12,000 feet in the air, and then the fun begins with his aerobatics. He loses altitude all the time, however, and when down to about 2,000 feet, he opens his parachute and descends in the conventional manner.

He can open and close his wings, or fold them up to his side as desired, and by means of the stabilizer-elevator attached to his legs, can loop, barrel roll and all the rest of it. This is surely a good stunt.

New Army Field Dedicated

HAMILTON FIELD, the Army's newest air base, was opened in December and is now the home of the fastest bombing outfit in the Air Corps, the Seventh Bombardment Group.

The field is 7 miles north of San Rafael, California, and is located at a strategic point in our coastal defense. Protected by natural features of terrain from enemy guns should a hostile fleet approach the shore, its position will enable the big ships based there to reach every important spot along the Pacific in the shortest possible time.

Fifty of the latest type Martin bombers will comprise the group. The personnel consists of 800 enlisted men, 79 officers, and 70 non-commissioned officers.

Hamilton Field was named for Lieutenant Lloyd A. Hamilton of the 17th Aero Squadron, who was killed in aerial combat in France after shooting down 9 enemy planes. The post is one of the most beautiful in the Army.

The Airmail Must Go Through

by LIEUT. H. LATANE LEWIS, II

You have heard the above slogan often, but here the author tells just what risks are taken and what dangers are frequently braved in keeping up the traditions of the airmail carriers.

"THE mail must get through" is the credo of all pilots flying the air mail.

During the freezing winter months pilots face their hardest task. They battle high winds, raging blizzards, intense cold, sleet, fog, and the dread of all airmen—ice. They battle the elements with a courage and perseverance that is nothing short of heroic.

Frequently, air-mail pilots scrape wings with tragedy and disaster ever lurking about them on all sides as they wing across frozen, snow-bound stretches of desolation. When mail planes have cracked-up pilots have, in a number of cases, somehow managed to get out of the wreckage alive and heroically struggled to get the mail through.

One of the most thrilling and heroic incidents of our air-mail service is that of pilots Jaxon and Bruger when they flew into the very jaws of death, battling a blizzard over an isolated section of "Hell's Stretch"—the graveyard of aviation—taking the mail over the treacherous hump of the Allegheny Mountains, the most dangerous night hop to be found in America.

The regular eastbound transport-mail plane has just taken off in the darkness of a chilly winter's night from a mid-western airport. The mail at this period of the winter is always heavy. Postal authorities have ordered an extra plane to get mail to the eastern seaboard for tomorrow's delivery. The only plane available is an old multi-motored all-metal cabin job that has seen better days. As there are no passengers in the ship Jaxon and Bruger tell us we can hop the mail—at our own risk.

"Why risk?" you ask.

Well, the thermometer at the mid-western airport is at zero and that means we'll hit 30 to 40 below zero when we get upstairs. The barometer has been falling all day—a sure storm warning. And we're to take off a few minutes before midnight.

What's this! Co-pilot Bruger with heavy winter flying suits and parachute packs comes up and tells us to get into the togs. Doesn't it strike you as odd? It does me. The cabin will be heated and we won't need these heavy suits. And why the parachutes?

Between you and me, I don't like the looks of things—flying suits, parachutes, the wind blowing and howling, zero weather, and a falling barometer. We are in for a tough go. But let's get into the suits and I'll help you strap your 'chute in place. Now you can do the same for me. Boy, with all this rigging on I feel more like a diver getting ready to go down forty fathoms under the sea instead of hopping the mail forty hundred feet above the earth.

The combination of a pea-soup fog and a mountain side caused this disaster. This danger is now largely overcome by the use of improved instruments.

SOME hours later we are rolling in a gusty, icy wind that knocks the big ship all over heaven's vacant lot. Outside the cabin window the thermometer reads 30 below zero. Hail rattles on the window panes. If the hail should stick to the wings and form into sheets of ice—then look out. The weight of the ice will force us down.

Can you catch sound of a man's voice coming from the earphones Bruger wears? I can. Listen!

"All eastbound transports ordered grounded immediately. All eastbound transports grounded immediately. Sleet and strong wind; velocity forty to fifty north by east, visibility zero. Report Bellefonte."

"Get it?" Bruger asks Jaxon. "Can you make Bellefonte?"

The pilot at the controls nods his helmeted head. His face grows grim, straining with tension. He's thinking fast. Thinking of the dangers ahead—weighing his chances of getting the mail through.

"Bellefonte ordered transports down. Nothing was said about mail ships. We'll try to get through."

It looks like we are in for plenty of tough going and danger..

Look down and ahead at those flashes of amber and red—the devil's lights showing the way over Hell's Stretch. We nose into that dreaded "graveyard of aviation." Here, last year, over the same mountains, treacherous elements sent Pilot Ames and others to their deaths.

The beat of our thundering engines has increased. The tachometer shows the prop revolutions have been stepped up from 1,400 to 1,650. Now it's 1,700. Look at the altimeter needle. We're climbing!

Jaxon calls out so his voice can be heard above the rattling of the old cabin job. "I hope to get a tail wind upstairs. We need a good five-thousand-foot clearance, on a night like this, to take us safely over the graveyard hop."

We look outside and a little shiver runs up my spine. Naw, I'm not scared. Only it's getting chilly in this cast-iron crate. Besides, you don't look so happy yourself.

The engines are beating faster. Sounds like they are laboring. Let's move up behind the pilots. I can't shake off the disquieting feeling that something—something terrible—is about to happen.

Look! Jaxon has sauced his engines up to almost 2,000 revvs. The altimeter points to 4,200 feet. Why we've only about 2,200 feet clearance for Rattlesnake Mountain that shoots 2,000 feet up into the wintry night somewhere dead ahead. That's too close for safety and comfort in a storm like this. If a down current should hit us—we'd go down so close that . . .

Bruger shouts: "The radio has failed!"

We feel the ship buck and roll. Our hearts sink and we take up a notch in our belts to maintain courage. A howling wind screams around the ship like ten thousand ghosts on the warpath—if ghosts go on the warpath. A thick murky greyish white blots out the sky and the earth. It's impossible to see anything. The beacon lights, stationed at strategic points by the government, are blotted out. They were to have led us safely over Hell's Stretch. Now we're in a helluva pickle. No beacons, no radio.

Look! The altimeter is sinking off. We've lost 500 feet in the last two minutes. And while we are wondering why we are losing altitude the altimeter hand slinks away for 700 feet in the next minute. Bruger calls to Jaxon in a straining voice:

"The hump is just ahead. If you keep on losing altitude you'll crash on its side. Can't you pull her up?"

"I can't get another foot altitude out of this old crate," Jaxon answers. "The engines are tearing themselves to pieces now. We're being pulled down by ice forming on the wings. We can't turn back. To try to turn in this storm would mean a crash. I've got to go on!"

"But you can't get over Rattlesnake Mountain." Bruger pleaded: "Veer off to the south."

"That would keep us in the path of the storm. We must go through it," Jaxon shouts in a desperate tone.

"Are you mad? You'll never make it," yells Bruger.

"It's our job to try," answers Jaxon coolly.

Disquieting thoughts race through our minds. Here we are in a metal boxlike cabin. A cell. We are prisoners of a mad storm. A storm bringing with it sleet and ice that clings fiendishly to the wings, the cabin, the tail surfaces. The weight of the ice is increasing at a surprisingly fast rate. Every few minutes the plane becomes pounds and pounds heavier. Already we are down to 1,800 feet. Two hundred feet below the hump of Rattlesnake Mountain on whose jagged stony sides other daring pilots have crashed to their doom.

We are startled by Co-pilot Bruger's quick movement. He leaves his seat, makes his way along the cabin to the rear side door. His hands run hurriedly over his parachute rigging. Clutching a Very pistol in one hand he reaches for the door handle. He yells his answer to our inquiry what he is about to do.

"The ship is so weighted down with ice she can't make the hump. I weigh a hundred and eighty pounds. I figure if I bail out it will lighten the load and Jaxon can skim over the mountain."

For a moment we are dumbed by this cool, calculated display of heroism. We know what it means to Bruger to "step outside" in this raging icebound blizzard.

(Continued on page 328)

Something New in Lightplane Design

This is a view of the "Blue Bird," new "teardrop" type of lightplane designed for the private owner.

WITH the incorporation in January last of the National Airplane and Motor Company of Billings, Montana, general production started on the *Blue Bird*, a lightweight aircraft with a "teardrop" body and a "beam" fuselage.

These two changes, together with the locating of the center of gravity in the center of the plane, constitute the principal departure of the inventor from accepted methods of design. And in keeping with the structural changes is the price—less than $1,000.

To see the plane, an open, two-place land monoplane, one is unimpressed, in fact, a trifle disconcerted by its buglike shape; but to fly it and handle the controls quickly convinces one of its flying ability.

Its steadiness and stability in the air, its slow take-off and landing speed—27 miles per hour—and its cruising range of 350 miles, tend to make it an outstanding plane in the class field it is planned to serve. The ship will do an hour in the air on 2½ gallons of gasoline, cruising at 75 m.p.h. and can attain a top speed of 85, all of which contributes strongly to its adaptability for serving the area reached by the Billings factory.

In this mountainous and semi-mountainous region, reside many stock ranchers, whose flocks of sheep and herds of cattle range far and wide, and who, from time to time, desire accurate and rapid check-ups; in this locality are also countless Utopian spots for the hunter, the fisherman and the week-end vacationist—spots now reached only after long automobile drives over crowded highways and rough side roads or perhaps by arduous pack trips.

There are scores of summer homes owned by business men who desire to commute between their mountain retreats and their places of business but who cannot because of the prohibitive distance. And it is these people and their pressing need for such a low price, low maintenance cost aircraft that induced the officials of the new airplane company to locate their first plant in this territory.

The ability of the *Blue Bird* to make use of any small area as a landing field—an open mountain meadow, a clearing in the forest, a level lakeshore, a hay or stubble field or a large lawn, further adapts it to the general needs of the great northwest. The city owner-operator needs only an ordinary open field in order to safely set the ship down.

Several qualities of the *Blue Bird*, the value of which are at once apparent to the experienced pilot, offers the novice, too, a sense of familiarity and security. For instance, it is almost impossible to put the ship into a spin when pulled into a climb as it will oscillate when the pull of gravity overcomes the pull of the motor. Likewise, there is little chance to roll, stall or dive the ship. Without the pilot touching the controls, it will remain its stability in flight and without guidance will make a perfect three-point landing.

A two-cylinder, opposed *National 35* motor that develops 35 h.p. at 2,500 r.p.m., powers the plane. The engine has a two-throw, counterbalanced crankshaft and a 4-inch bore with a 3⅝-inch stroke. Chrome-nickel cylinders, aluminum pistons and crankcase

(Concluded on page 334)

Spinning Characteristics

by NEIL W. PERDEW

This is an analysis of the causes of spinning and suggestions for the cure for this tendency in the design of the plane. You will find this article an excellent non-mathematical treatment of this complex subject.

THE low-wing monoplane is well known for its desirable qualities, appearance, vision, minimum aerodynamic resistance and flying qualities.

Nevertheless, in spite of these advantages, its development in the lightplane class in this country has been quite limited and few airplanes of this type have successfully passed the Department of Commerce flight test requirements. The principal difficulty has been to design the proper spinning characteristics into the airplane.

A great deal has been written and many investigations undertaken on the cause of bad spinning characteristics in airplanes and various methods have been evolved. However, a large percentage of the research along this line has been undertaken from a theoretical standpoint with the theory sometimes failing to work out in practice and some difficulty is still being experienced in designing low-wing monoplanes which have good spinning qualities.

The writer has developed a low-wing monoplane which successfullly passed the Bureau of Air Commerce tests over a year ago and had an opportunity in the designing and flight testing of this airplane to make a thorough study of the problem and witness the results of the various changes made during the course of the flight testing to finally obtain a ship which now will recover from a six-turn spin in one-half a turn.

To begin with, let us approach the theoretical factors involved. It is not the purpose of this article to investigate the problem from a mathematical angle, but to list the important factors involved in order to clarify the design problems.

First: Let us investigate the center of gravity position. Owing to the fact that the wing on this type of airplane is below the center of gravity, the C.G. must be carried somewhat ahead of its position customary for biplanes and high-wing monoplanes. It should be far enough forward so that the resultant through the C.G. comes ahead of the foremost center of pressure position on the Mean Aerodynamic Chord of the wing when the wing is in the high angle of attack position or at the stalling angle.

Forward three-quarter view of the plane designed by the author of this article with a view of investigating the cause of spinning.

Otherwise, the airplane on reaching the stalling angle of attack will tend to stall farther, will be unstable and may develop flat spinning characteristics. At least one airplane has passed Bureau of Air Commerce tests with the C.G. behind this point by keeping the spinning range between the primary and secondary peaks to the lift curve of the wing used on that particular airplane, a questionable expedient. Although there is no evidence that the few airplanes of this make put in service gave spinning trouble, it is apparent that slight changes in loading might affect its qualities adversely.

Secondly: The wing loading affects spinning characteristics considerably. In general, a light wing loading will be less prone to develop bad spinning qualities than a heavy one. This is probably due to the fact that the rate of autorotation, or spinning, increases with wing loading and in a rapid spin centrifugal forces are set up which have a tendency to make the spin flatten out. With a heavy wing loading, 9 pounds or more per square foot, greater care must be taken in designing the airplane to overcome any tendency to spin flat.

Third: The position of the tail surfaces should be far enough back of the wing to be outside the area blanketed by the wing in a spin. In some tests, it has been found that the effective angle of attack at the wing tips reaches as high as 60 degrees in a spin. Therefore, the tail surfaces, to be outside of the blanketed area, should be far enough to the rear of the wing that a line, 60 degrees from a perpendicular to the chord line, will clear them. This is a factor that I believe has been overlooked by many designers and may be the cause of their airplanes' inability to recover satisfactorily from a spin.

Fourth: The relative position of the tail surfaces should be such as to avoid blanketing of the rudder and fin by the stabilizer and elevators. The path of airflow over the tail surfaces in a spin is upward and to the rear. The stabilizer and elevators blanket that portion of the fin and rudder above them, and as the fin and rudder are most effective in opposing a spin, their efficiency is greatly reduced by this blanketing action.

The stabilizer should be large enough to give good static and dynamic stability in level flight. The elevators should have adequate area for good control. The fin should be large enough

Rear view of the plane designed by the author.

to give good directional stability and the rudder large enough to give very sensitive control in the air.

The rudder area is perhaps most important as the spin is largely controlled by the rudder. Besides the rudder must be so designed as to give a large effective area, that is, the area should not be blanketed by the horizontal tail surfaces in a spin.

That portion of the rudder below and to the rear of the elevators is most effective so the type of rudder with the largest chord near the bottom offers the best possibilities. In the writer's airplane, the rudder was of this type and in addition extended some 14 inches to the rear of the elevators in order to provide a large unblanketed area.

The flight testing of this airplane was carried on over a period of several months and spins of several types were obtained and corrected by various means. The writer was fortunate in obtaining the services of Col. Clarence D. Chamberlain for flight testing the airplane and a great deal of the success of this testing was due to his efforts.

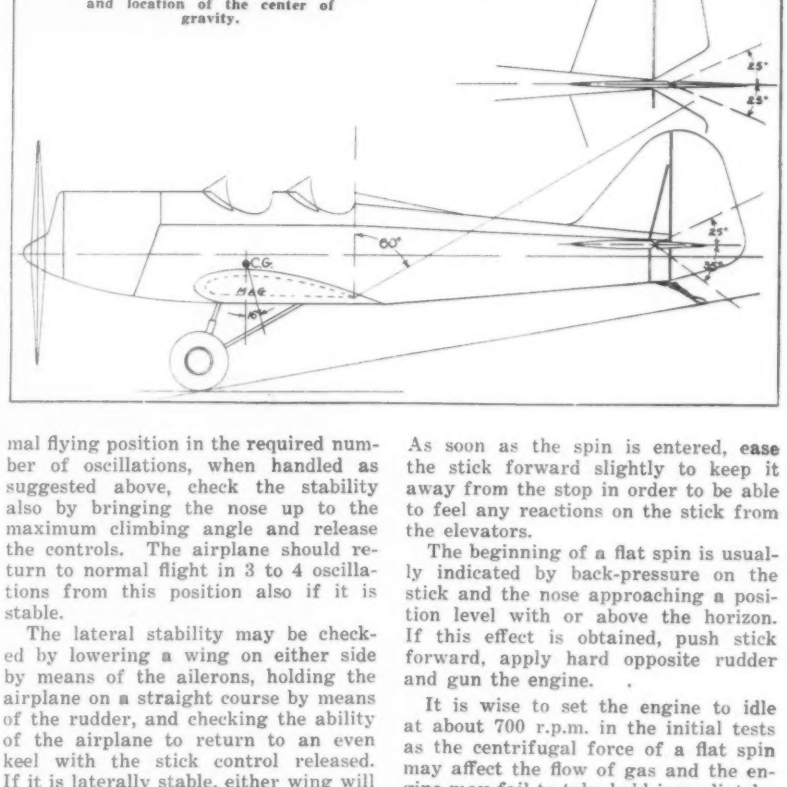
In flight testing any airplane, the first factors to determine are controllability and general stability. Before any spins should be attempted, the airplane should be carefully tested for stability. If this rule is followed, fewer spin troubles and accidents will result. A copy of the Bureau of Air Commerce flight test procedure should be obtained and carefully followed. Too much haste to try out the spinning characteristics, before stability problems are overcome, may easily lead to a bad accident and can gain nothing as the Bureau inspectors will not spin test an airplane until they are satisfied with the stability.

Probably, the most important factor is that of longitudinal stability. To test this, set the stabilizer for trim at cruising speed, dump the airplane over at about 45 degrees and release the controls. If the airplane is stable it will return to level flight in three or four oscillations. If unstable, it will oscillate indefinitely.

If the plane does not return to level flight within a few oscillations, it indicates that the C.G. is too far to the rear, that the stabilizer is too small or that the elevator controls are not operating freely. If the stabilizer area is approximately equal in percentage of wing area to that of airplanes known to spin satisfactorily, and the elevators are free enough to fall of their own weight when the controls are released with the ship on the ground, it is probable that the C.G. is too far aft.

In this case, add weight to the nose of the ship or lighten the tail to move the C.G. forward and test the airplane again, adding weight in the nose in units of say 5 pounds, light testing for stability after each addition until the desired stability is obtained.

If this doesn't correct the difficulty, it indicates that a larger stabilizer is needed. If the airplane returns to normal flying position in the required number of oscillations, when handled as suggested above, check the stability also by bringing the nose up to the maximum climbing angle and release the controls. The airplane should return to normal flight in 3 to 4 oscillations from this position also if it is stable.



Distribution of side surfaces, arrangement of the tail group and location of the center of gravity.

The lateral stability may be checked by lowering a wing on either side by means of the ailerons, holding the airplane on a straight course by means of the rudder, and checking the ability of the airplane to return to an even keel with the stick control released. If it is laterally stable, either wing will come up without aid from the pilot. Lateral stability may be improved by giving the wing tips a greater angle of attack than the remainder of the wing, lowering the C.G. or increasing the dihedral angle.

Directional stability is largely dependent on the fin of the airplane. To check it, maintain the airplane on an even keel with the ailerons and elevators, kick rudder and then release the rudder controls. If the airplane tends to return to a straight path it is directionally stable. If it turns to one side or the other compensate for it by moving the leading edge of the fin. If this fails to correct the tendency to keep on turning a larger fin should be provided.

When the stability is entirely satisfactory, then spin tests can begin. No spinning should be attempted below 5,000 feet on the initial attempts and the higher the safer as planes have been known to lose as much as 500 feet in each turn of the spin. A one- or two-turn spin should be tried, left and right, and if recovery is immediate, gradually increase the number of turns by one-half a turn each time until six turns have been made either side and recovery obtained in not more than a turn and one-half.

To enter the spin, the airplane should be given hard rudder when completely stalled and held in the spin with the rudder hard over and stick back. As soon as the spin is entered, ease the stick forward slightly to keep it away from the stop in order to be able to feel any reactions on the stick from the elevators.

The beginning of a flat spin is usually indicated by back-pressure on the stick and the nose approaching a position level with or above the horizon. If this effect is obtained, push stick forward, apply hard opposite rudder and gun the engine.

It is wise to set the engine to idle at about 700 r.p.m. in the initial tests as the centrifugal force of a flat spin may affect the flow of gas and the engine may fail to take hold immediately. The plane may recover without using the engine, but the longer a flat spin persists, the harder it is to recover so there is no object in letting it develop.

The writer's airplane was a difficult one to get in a spin, some pilots being unable to spin it at all. It had to be completely stalled and kicked in hard or it would make a turn of a spiral and come out.

The velocity with which an airplane enters a spin greatly affects the speed of rotation and the quickness of recovery. If an airplane spins at a high rate of speed, this can be limited somewhat by limiting the rudder movement by means of stops at the rudder horns to 20-25 degrees of movement either side of center line.

This action will hardly affect the rate of recovery from a spin but will limit the velocity with which an airplane may be thrown into a spin. This is not such an important factor in an airplane with light wing loading, but as the more heavily loaded airplanes spin at a high rate of speed it is advisable to limit the rudder movement in the beginning in order to hold down the rotative speeds as much as possible and obtain a more easily controlled spin.

Also, the elevator should be rigged to give more down movement than up in order to aid recovery. The upward

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About Your License Tests

by HERBERT D. PUTNAM

Former inspector for the Bureau of Air Commerce, Department of Commerce.

What to do and what not to do when you face the inspector before taking your tests—and after. A useful code of etiquette for the student.

HERE are some suggestions for the novice that may be of assistance whether he intends to follow aviation as a career or fly only for his own amusement. These "do's" and "don'ts" have been gathered from a rather wide experience and are intended to help the young pilot in his endeavor to obtain his Bureau of Air Commerce license.

The first to remember, when coming up for test for license, is not to get "Inspectoritis." Most of the inspectors employed by the department are pretty good fellows, are seasoned pilots, conscientious and willing to go out of their way to help the novice.

Don't alibi or make excuses. Don't be afraid to explain should there be a misunderstanding. The inspectors know all the answers to alibis and excuses and when the applicant comes up for test with his papers made out sloppily or not at all, with pictures still at the photographers and a lot of other excuses about not having time, etc., the inspector starts to make his decision against the applicant right then and there, and it will take above an average performance for the inspector to overcome, in his own mind, the adverse opinion gained at the outset by carelessness and laxity on the part of the applicant.

Flying is not an avocation for the careless, for you are not allowed any mistakes when in the air. The careless person makes a very poor pilot, also a very dangerous one, consequently the inspector is not overjoyed in giving a test to such an applicant since the primary purpose of the Air Commerce Regulations is to make flying as safe as possible. It is the inspector's duty to detect lack of ability or dangerous habits and insist upon their elimination before issuing a license.

Statistics published by the Aeronautics Branch show that there are three dangerous periods in any pilot's career. First: After the student has accomplished the tests and has been issued a private license, or say, at seventy-five hours. Second: At about one hundred fifty hours. Third: At about two hundred fifty hours. Statistics show that accidents decrease as hours increase and that, whenever a pilot gets it into his head that he has it all down pat and knows all about flying, he is riding to a fall. The price of safety in flying is constant vigilance.

Certain things are required of the young pilot before an inspector will pass him and issue a license, the most important factor being that he shows ability to fly. This sounds foolish but it is a fact that hardly one applicant in ten that applies for a private pilot's license seems able to really make an airplane fly. A lot of this is due to poor instruction and there is plenty of that because instruction has been the chief source of income for many men who have been able to convince some inspector of fair ability and who have been issued a transport license.

The first thing that one of these fellows does is try to put his license to work for him and obtain compensation for his efforts in some way or other. The chief job is instructing, hence we have a transport pilot who is still in embryonic state so far as experience goes, imparting his ideas to a novice with the result that the fledgling makes a habit of all his own mistakes and those of his instructor in addition.

Upside down above the clouds. Many a student's ambition—but see the inspector first.

After his solo, he is told that all he has to do is put in time until he has enough hours for one of the higher grades of license and, coupled with study of Air Commerce Regulations, Air Traffic Rules, Airplanes, Engines, Navigation and Meteorology, he may present himself to an inspector for test in one of these higher grades.

When this happens, the inspector finds, not a limited commercial or transport pilot but a 200-hundred hour solo pilot slightly improved in skill but with all of his old mistakes and some more added. The result is that the applicant is turned down and told to re-apply in ninety days

It is really surprising how many such cases exist in the country today. Just what to do about this phase of aviation is a matter of much thought. Most young men want to fly, the magazines have been full of the heroic and pseudo heroic exploits of pilots, both military and commercial, and all you have to do is hang out where a few pilots congregate and listen to the stories told to get a pretty accurate idea of the foundation that the novice gets. Most of it is silly rot with a piece of choicest wisdom thrown in here and there, but the novice is totally unable to sort the wheat from the chaff and consequently absorbs many false ideas which work to his downfall later on.

The choice of an instructor who has been approved by the Bureau of Air Commerce will prove to be the best in the long run and he will be found employed by an approved school. Their equipment will also be found to be of the best and their course will be as outlined by the Bureau. The student will get thorough training here, though it is only fair to say there are many fine instructors who are free-lancing or who are employed by operators who are not approved by the Bureau of Air Commerce.

If one of these men is selected to do the teaching, no harm will result because he will know from experience what is required and will do his best to impart it to the student and not allow the student to come for test unless the student is ready. The test outlined in the Air Commerce Regulations is a group of maneuvers designed to reveal to the inspector whether the student pilot has learned to fly the airplane or whether he is merely taking a ride and with fair luck will make a landing somewhere near the indicated spot.

The ability, for instance, to answer ten questions on Air Commerce Regulations and Air Traffic Rules and to successfully accomplish the simple maneuvers required for a private pilot's license does not require much experience and when he cannot give a good account of himself in this simple test he is by no means safe alone in any kind of an airplane.

When taking a test remember to taxi slowly. When you get into position for take-off, turn the ship at right-angles to the runway or in such a position to get an unobstructed view of the approach to the field and be sure all is clear behind you. Several bad accidents have been caused by one ship landing on another. This is one thing that all pilots will do well to remember and it is a practice that a lot of good pilots, including airline pilots, neglect. It has been noted many times in the last year that many seasoned pilots will taxi to the runway, get into posi-

tion for the take-off, run up their motors and then without more ado, will open the throttles and barge down the runway.

The pilot's cabin on most airliners affords little or no rear view so when you get on the runway be sure that your motor has been run up, that the gas is turned on both tanks, that oil temperature and pressure are okay and that the approach to the runway is clear in all directions. Then taxi out on the runway and take-off without any hesitation.

Another thing of importance is to open and close the throttle slowly. This is a fault with most pilots today. They slam the throttle open, grab the stick or wheel in a bone crushing grip, brace their legs against the rudder until their knees tremble and then, with grim determination, go flying down the runway for a take-off.

As a matter of fact, if they would relax and make their movements slowly and easily they would be better pilots. This also applies to movements of controls while in flight. A common fault is chasing the bumps all over the cockpit with the stick. Corrections should be made slowly except in very exceptional cases, for this avoids overcontrolling, a fault with many pilots and one that is readily observed by the inspector in a test.

When approaching the field for a landing, and after leveling off a few feet above the ground as the speed decreases, be careful not to get the habit of pumping the stick forward and back. When leveling off, bring the stick or wheel, as the case may be, slowly back until the desired position is obtained and, as the speed decreases, ease the stick or wheel back more slowly and all the way.

Remember, once the control starts back for a landing it never goes forward again unless you open the throttle and go around to try for a landing once more. It is always the best practice, if you bounce bad enough, to give it the gun, then leave it on and go around and try again.

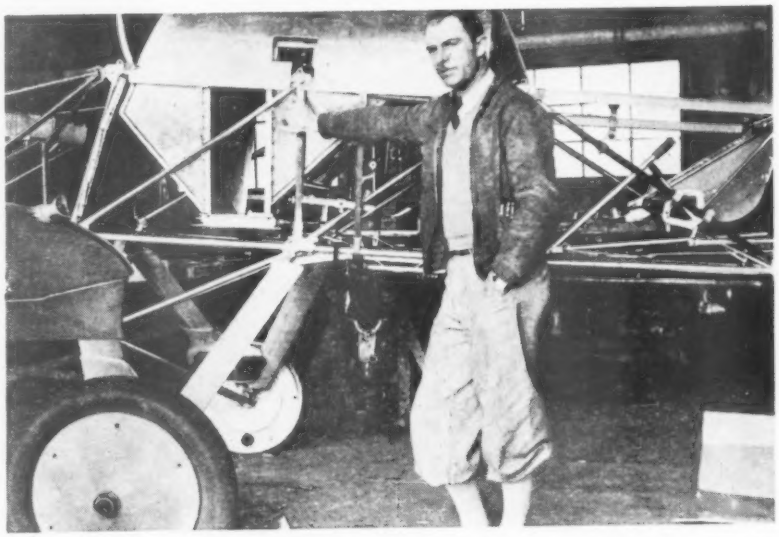
Flying is a matter of timing just like golfing or batting a pitched ball and with this habit of timing developed a pilot can easily change from one type of ship to another.

Make out your application, have it notarized, get your pictures and have your logbook up-to-date and certified as required by the Regulations. Obtain from the Regulations the maneuvers you will be required to do and practice them until you know in your own mind that you can do them. Then have your instructor check your flying and if he makes any corrections, be sure you have noted them carefully and complied with his instructions.

Study Air Traffic Rules and Air Commerce Regulations carefully. Then present yourself promptly at the time the inspector's itinerary indicates he will be at your field. Don't try to kid

(Concluded on page 336)

How Dusting Planes Are Built



The hopper for the insecticide is at the left and in the front of the fuselage.

PLANT dusting operations by which insecticides are spread over fields and orchards for the suppression of insects, fungus and similar pests, are rapidly improving because of the developments made in the apparatus used.

Dusting is not only being done more effectively than before, but also more economically and with a less waste of the insecticide or disinfectant. The powder must be spread over the ground with uniformity and under complete control to insure the best results, and this is the purpose of the highly developed apparatus shown here.

This hopper was developed by a California specialist in crop-dusting after several years' experience in this work. The uniformity with which the device operates makes it possible to lay down the proper amount of insecticide specified per acre and thus makes it possible to accurately quote prices on the work done.

Electrically Lighted Airport Tee

A LARGE electrical manufacturing company has designed a highly effective "wind-tee" for airports which is clearly visible, both day and night, from considerable altitudes. It is far superior to the common home-made tee that one sees at the various small airports.

Roughly, it takes the general form of an airplane, but with bright and distinctive striping that is easily observed in daylight. At night, the incandescent lamps along the legs of the tee are also clearly visible.

This is the airport wind-tee, conspicuous both by day and by night.

The New Aviation Gasolines

by KEITH J. FANSHIER

Super-engine fuels registering a 100 octane rating are now in sight. Perhaps they will be blends or perhaps synthetic, but they are coming with attendant improvement in engine performance.

MOTOR fuel of quality and of performance potentials totally unguessed and unpredictable only a few years ago, is almost ready to be offered to aviation to keep pace with the unquestionable trend toward greater power and speed in aircraft engines today.

It probably will be only a short time until aviation will be using in more or less commonplace fashion motor fuel which could not have been foreseen in its possibilities by the leaders of only a few years ago.

To get down to specific cases, octane numbers of motor fuels that are "just around the corner (no kidding)" will be 100, and perhaps even somewhat higher. This is considerably higher than the octane rating of the motor fuel demanded in the Army and Navy under the highest known recent classification, fighting grade aviation.

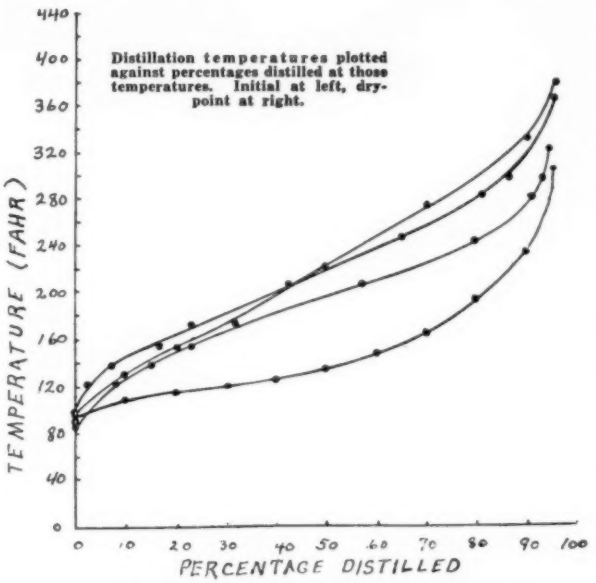
Commercial aviation can and will get 100 octane motor fuel shortly, in all probability, and can use it in advancing performance standards. And military aviation certainly will receive the benefit of it. As a matter of fact, 100 octane gasoline actually has been used in some instances of testing and trial nature and has come through with an excellent performance record.

In the first place, it would be well to emphasize that 100 octane motor fuel will not, strictly speaking, be a natural petroleum product, but that it will be a synthetic product. It will be the result of blending products of high anti-knock value and it is not going too far into the realms of the future to say that the figure of 100 octane for a motor fuel sooner or later will be substantially exceeded.

What does this signify? In the opinion of the writer, based on the beliefs of motor fuel technical authorities of high repute, it imports that there is a day coming—soon—in which it will be possible to squeeze from the gallon of motor fuel that goes into the tank speed and power far in excess of anything yet known in aviation. Within reason, the limits which better motor fuel will permit aviation engine performance to reach are not yet definitely fixed. Therein lies a real thrill for those genuinely interested in the future of aviation and its importance to the nation and to the world.

Airplane engine design may be somewhat radically affected by the fact that such fuel is available and has possibilities in its general use, it is the opinion of authorities. In fact, modification of airplane engine design would seem to be desirable or necessary in most cases for the utilization of the maximum results in the case such high grade motor fuel is in the tank.

A most important element for the consideration of such fuels by commercial aviation is the cost; not so much the cost per gallon, as the cost per unit of performance whatever it may be. The preliminary results from the use of such fuel have caused various experts to reach the opinion that under the proper conditions of use, 100 octane motor fuel or motor fuel of even higher rating can be made to be the most economical fuel. And that is something for commercial aviation to ponder.



A picture of gasoline in terms of volatility in a distillation test.

Since it has come out that 100 octane gasoline was used at the Mitchell Trophy race at Selfridge field, Michigan, some five months ago, interest in aviation and petroleum industry circles in the facts has been growing. In these races, according to statements by army engineer authorities, it was definitely and conclusively proved, thus verifying the results obtained previously in laboratory tests, that an increase of eight points in octane number of a motor fuel over the old 92 limit resulted in a marked increase in speed.

In that race, there were about ten planes equipped for competition with high output engines which it is stated could not be opened completely near the ground. The race was won, competed in by standard service type pursuit planes only, at a speed slightly in excess of three and one-half miles per minute.

Stated First Lieutenant Klein of the air corps of the United States Army's material division: "The marked increase of 15 to 30 percent power output possible with 100 octane fuel over that obtainable with 92 octane (rated by the air corps method of testing) clearly demonstrates not only the advantage of this fuel, but more important, the extreme desirability from a military standpoint of adopting such fuel as a means of greatly increasing engine performance with relatively little increase in weight, provided that engines are designed to take full advantage of the higher anti-knock value fuels." His statement was made in a paper presented at the fuels section of the annual meeting of the Institute of the Aeronautical Sciences.

The data on which Lieut. Klein's discussion was based was the result of tests made upon four separate types of motor fuel, which then were tested in comparison with results from the fuel which is formally known as Y-3557-G, a product which rates at 92 octane. Fuel No. 1 was made up of 50 percent iso-octane plus 50 percent aviation gasoline, carrying 3 ml. lead.

Fuel No. 2 was 50 percent iso-octane with 50 percent aviation gasoline carrying 6 ml. lead. Fuel No. 3 was standard reference fuel C-6 with 8.5 ml. lead. Fuel No. 4 was 37½ percent iso-octane plus 35½ percent high anti-knock fuel high in aromatics plus 25 percent iso-pentane with one ml. lead.

The general results of the tests indicate the desirability of developing the 100 octane motor fuel with the reduced lead content on the contention that lower lead content reduces corrosion of the engine.

Anti-knock value, it was pointed out, has been found to decrease at the rate

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of about 1 octane number for each average 15 Fahrenheit degree increase in temperature of the mixture. Thus, highly supercharged engines in order to take advantage of the high anti-knock value of the fuel probably would require intercoolers for maximum performance on take-off at low altitudes, regardless of the anti-knock value of the fuel used.

It was indicated that there was no appreciable difference in anti-knock value between fuels No. 1 and 2, despite difference in lead content. In No. 4, the iso-octane was used to increase the anti-knock value of lead susceptibility of the aromatics and iso-pentane was added to reduce the A.S.T.M. 10 percent evaporated point so that it would conform to what is known as specification X-3575.

Lieut. Klein felt that the greater increase in power output obtained in a Cyclone engine as compared with a Wasp that was used was due to a special impeller used to give high supercharging to show as clearly as possible the value of 100 octane fuel in engines having high enough output available to take sufficient advantage of such fuel. With engines designed specifically for operation on such fuel, he felt that still greater gain in performance should be obtained especially in high altitudes. Here is a thought to keep in mind for future aircraft engine development and operation.

No less important and interesting to the future of aviation are the deductions and conclusions arrived at by other authorities along similar lines, applied to commercial aviation. And in this connection one of the most outstanding contributions to current information on the subject has been made by Dr. Graham Edgar, vice president of Ethyl Gasoline Corporation.

"The highest anti-knock fuels of today are made by distilling certain selected crude oils known to give gasoline of high natural anti-knock value, and adding tetra ethyl lead," he asserts. "This process appears to have reached an approximate limit around 87 octane number. Cracking processes in the present sense of the word, in which the higher boiling constituents of crude oil are broken down into material boiling in the gasoline range, appear today to offer no prospect of producing an aviation gasoline better than 87 octane number, either with or without addition of tetra ethyl lead.

"Hydrogenation has been said to be capable of producing gasoline of very high octane number, but there is conflicting information on this point and it cannot be said with confidence that this process can or will produce satisfactory aviation gasoline of anti-knock value substantially higher than 87.

"How then can gasoline of 100 octane number and above be made?"

Dr. Edgar goes on to suggest that it can be made most easily by breaking down the petroleum molecules into

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How Boeing Measures Plane Speed

Sighting the plane through a grid with a camera in determining the speed of the plane.

DEVELOPMENT of a simple but accurate photographic method of measuring airplane landing speeds is announced by the Boeing Aircraft Company of Seattle.

Equipment consists of a 35 m.m. motion picture camera, a wire grid and an anemometer for measuring wind speed. The grid, a large wood frame with vertical and horizontal wires evenly spaced, is set up ten feet from the motion picture camera which is carefully calibrated to determine the number of exposures per second. Cloth strips are placed 400 feet from the camera, parallel to the grid, to mark the line on which the plane must land.

As the airplane comes in for a landing, the camera is set in operation and wind speed is measured on the anemometer. Resultant motion pictures show the forward travel of the airplane and the angle of glide. By plotting the line of flight across the grid screen and by allowing for ground wind as measured on the anemometer, an accurate calculation of the landing speed can be obtained.

Boeing engineers have found that, after the film has been developed, the data can be obtained from it directly, or enlarged prints can be made and results determined from them. This is accurate because time lag is not involved.

England Has a Floating Dock for Airplanes

A FLOATING dock for flying-boats and seaplanes has been constructed in England for making repairs to marine aerial craft. It has a flat rear deck for carrying the plane in the proper position and on either side are two jib cranes for lifting the aircraft on board.

The interior of the vessel is provided with complete workshops.

The floating dock for seaplanes and flying boats.

World's Largest War Museum

by GEORGE HURST

Jarrett's collection of war relics, and particular aviation relics, is famous. Here is a brief description of the Jarrett museum and its history.

MOST World War plane fans are content to make regular and frequent journeys to the city library and delve through musty and ancient publications to find performance and specification figures of military planes of '14-18.

Others take their shears in hand and wait patiently to demolish each issue of POPULAR AVIATION by cutting photos out before the rest of the family has a chance to read about the latest Skybuster monoplane. Then there are a few who are satisfied with nothing but actual snapshots taken during the war by Richthofen himself.

All of you "aforesaid" fans go way back and sit down. Make way for G. B. Jarrett because, when he was bitten by the research bug, he was not satisfied until he could collect actual wartime ships and build those he couldn't secure.

Jarrett started his collection in May, 1915, at the age of 17. His trophies consisted of two small buttons given to him by a returning American ambulance driver who had been wounded. One was a German and the other a French button. At the close of the war he was on hand at the training camps where demobilization occurred and started to purchase souvenirs to the full extent of his pocketbook. The articles he secured made a very nice den collection at his former home in Haddonfield, New Jersey.

By this time the collector's fever had a firm grip on Jarrett and has never broken. In 1922, he went to Europe and visited the battlefields and started collecting on a grand scale. In 1926, arrangements were made with the Government for a donation of obsolete material. He bought heavily, wherever he could make purchases, and as at that time material was fairly cheap his funds went a long way. In 1928, when he was touring the eastern states for the various veteran societies, he had

Here is an outdoor group of World War planes at Artillery Storage Park, a prominent part of Jarrett's collection. This will be of particular interest to our Photo Phans.

around 4,000 pieces for his museum with a shipping weight of 4½ tons.

In 1930, Steel Pier, Atlantic City, New Jersey, became interested in Jarrett's museum and gave him space at their amusement place. This was quite welcome as it was not feasible to hang D.H.'s from chandeliers and as an artillery piece takes up a bit of room in the library as well as being fairly hefty on the floor.

Steel Pier chipped in some funds for expansion. Four years ago, Jarrett made another trip to Europe and purchased 1,100 new pieces weighing 3½ tons on shipment. To date, the Jarrett museum contains over 7,000 pieces that have a total weight of over 40 tons. The museum consists of airplanes, artillery pieces, kitchens, various rolling stocks, wagons and autos, small arms and machine guns, shells and general ammunition displays, uniforms and equipment on life-size figures, over 4,000 photos, posters and maps, and a host of small miscellaneous articles.

Among the autograph collection are the names of Roy Brown, Pinsard, Rickenbacker, Bishop, the Kaiser and Crown Prince, Udet, von Schleich, Mitchell and Vaughn. Just before the past Christmas Pinsard, the French ace with 20 official victories, sent Jarrett his wartime cap.

Jarrett's weakness is World War planes and he loves them as if they are alive. The ships consist of a Spad 7, Nieuport 28, Sopwith Camel, American deHaviland 4, Thomas-Morse Scout, Avro two-place trainer and a Fokker Triplane.

The Spad 7 was actually flown during the World War. It was brought to the United States by the Paramount Studio for "Wings." This Spad has been in every motion picture studio on the west coast at some time or other. It has traveled across the continent twice. Dick Grace, famous stunt man, cracked it up for a movie thriller. Jarrett purchased it from Balboni, the airplane junkman at Los Angeles and rebuilt it in Atlantic City. Today it stands protected in the museum, painted as was Guynemer's own.

Jarrett claims that there are, at present, only three wartime Sopwith planes in the States today. Two of these are Snipes and one a Camel. The Camel is in the Jarrett Museum of World War History and came from none other but Clarence Chamberlin. The Fokker Triplane is not original but a replica with some real parts as wheels, guns and controls. In the future, Steel Pier plans to make an Albatross replica. Mr. Jarrett holds options on the following ships: SE-5, Fokker D-7, RE-8, Martinsyde and a Pfalz D-12.

Last fall, the Steel Pier outfit held a field day. The program was given at the storage farms where the larger pieces are housed. The ships were wheeled out, fully rigged and some of the artillery pieces fired. Three hundred guests attended.

That *is* something. Two buttons to a collection of World War airplanes!

END

FROM LEFT TO RIGHT: A Spad 7, a Sopwith Camel, a Nieuport 28 and a Thomas-Morse Scout.

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A Brand New Slant on

by

GLENN D. ANGLE

Prominent authority on aviation engine design and automotive equipment.

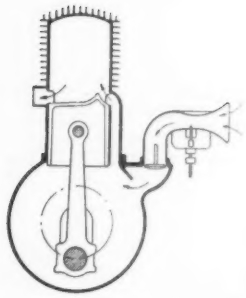


Fig. 1. Diagram of the two-port two-cycle engine invented by Day. Mixture is compressed in crankcase.

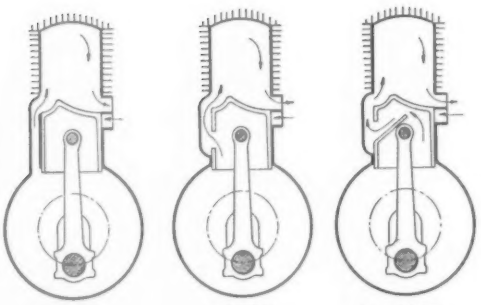


Fig. 2. Diagrams of various types of two-cycle engines having crankcase compression and with various port arrangements. Improved scavenging is the objective sought.

IT is an accepted fact that hundreds of young men and women in this country desire to own and fly an airplane. Most of us know this situation has existed for quite a long time, and that it becomes more perspicuous as the months and years roll by. Not so long ago, conclusive evidence of this demand was brought to our attention by the affirmative replies to the questionnaires distributed by the Aeronautics Branch of the Department of Commerce.

Now, in the face of these facts, one has a right to ponder over the circumstances which impede the development of this market. He may wish to know what constructive progress, if any, is being made toward producing the type of airplane acceptable to the majority who are interested. And this does not mean only an airplane that is satisfactory from the standpoint of performance and safety, but one that will sell.

Whether such an airplane finds business or pleasure its principal useful application is of no great concern for the moment. As a matter of fact, we need not dwell upon its desired performance and safety features, since our engineering talent generally leads us to satisfactory solutions for problems of this nature. In the writer's opinion, this is primarily a matter of merchandising.

Of course, one frequently hears some well-meant arguments which might tend to prove that the demand for privately-owned aircraft can never become large enough to support an industry. Some insist that flying is unsafe for the average citizen, which is true perhaps within reasonable limits. But for that matter, no means of rapid transportation is absolutely safe at all times, and aviation does not seem to suffer greatly by comparison according to the best available records.

Others point out that one cannot fly always where and when he chooses—a fact that cannot be denied at the present time. The need for more landing fields in the future is conceded, but there is no wisdom in providing these facilities until they can be used extensively. This point becomes clear immediately if one asks himself this question—did the good roads bring automobiles, or the automobiles bring good roads?

Bad weather, especially fogs, continues to be aviation's greatest hazard, yet one never finds travel on land or water particularly safe or enjoyable under like conditions. Justifiable arguments, all of them, but let us leave them with the skeptics.

Those who possess vision and courage usually tackle each problem as it presents itself. In this instance, the first problem is cost. Everyone realizes that the initial cost and operating expense of the privately-owned airplane must be appreciably reduced, in fact, it must compare favorably with the medium- or low-priced automobile of the present day before any volume of business can be expected from this potential market.

Such simple economic considerations are commonly understood, of course; yet, I am not sure that everyone fully appreciates the nature or magnitude of the problems entering into a manufacturing and marketing program of this sort.

For this reason, I am urged to deal with one of the most important phases of the problem; namely, the production of a light, dependable engine which can be sold profitably at a low figure—let us say, three or four dollars per horsepower. It is not expected that these comments will present a complete solution, but they become justified immediately when some assistance is rendered to those vitally concerned with this particular problem.

The first question, among the many to be considered, is whether volume production of any existing design would lower manufacturing costs sufficiently. My answer to this question is no, although I believe, in some instances, that with certain structural changes—made economically possible with volume output—the cost might closely approach and, in a few special cases, actually meet the figures previously mentioned.

Unfortunately, the fabrication of a few hundred engines each year is not volume as it is known in most of the other lines of manufacturing. Consequently, we cannot speculate with any degree of security beyond the best anticipated number of airplanes that may be absorbed within the next few years.

The aviation enthusiast, who still visions thousands of citizens taking up flying suddenly, will be of no assistance to us in analyzing this problem. Furthermore, we must not base our opinions upon the history of the develop-

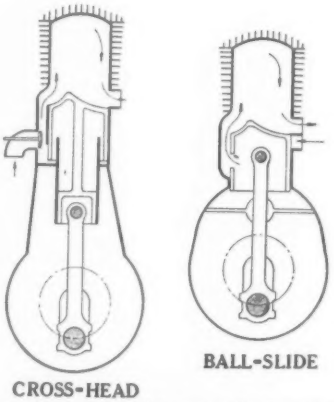


Fig. 3. Engines in which compression is secured and underside of piston.

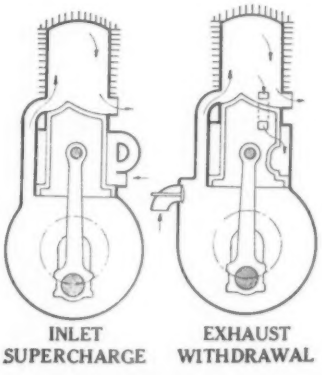


Fig. 4. Two-cycle engines employing differential pistons and crankcase compression.

Lightplane Engine Design

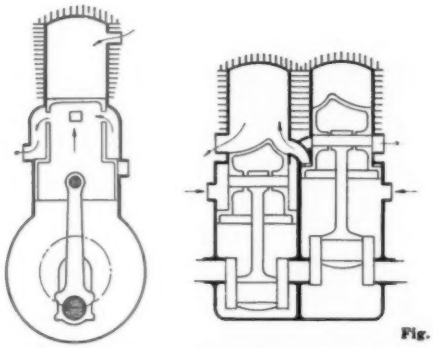


Fig. 5. Two-cycle engines with differential pistons which do not use crankcase compression.

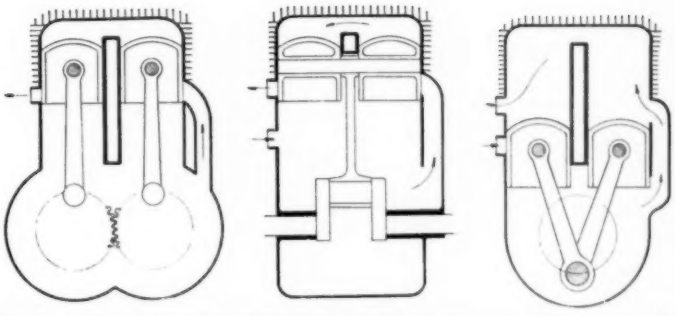


Fig. 6. Typical two-cycle engines of the "U" type piston and cylinder arrangement. Both pistons move together.

ment of the automobile industry. The two are not exactly parallel. The automobile replaced the horse, because the speed and range of operations were extended without a proportional increase in mileage expense. Volume production, with its lower unit costs, came as a most natural result of this greater utility.

The airplane does not appear so clearly in the role of a substitute means of transportation. It has speed primarily to mark its superiority over all other well-established methods of travel and, except for a comparatively small enthusiastic group whose numbers are gradually increasing, it ultimately becomes a matter of selling aviation to the expense-budgeting American public on the basis of economy alone.

With this thought firmly in mind, let us investigate the ways and means that economical private flying may become a possibility. We shall confine our study, of course, to the engine, which must be recognized as first in order of importance.

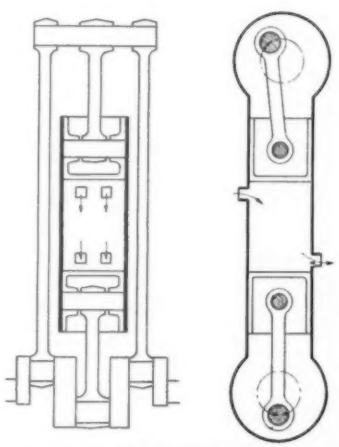


Fig. 7. Two-cycle engines of the opposed piston type.

I believe there are only two courses that may be followed to a successful conclusion. The first is the development of a new design or type of engine, whose simplicity insures low production costs regardless of quantity. The second is greatly increased production of some new design of the type now commonly used. This may come rather soon by way of employing these engines for other useful sources of power, especially in fields having a definite need for several thousand units each year. Let us now discuss some of the features of each plan in the same order.

If we set our minds to the task of developing a new design that can be produced at low cost in limited numbers, we are confronted immediately with simplification in one or more of its various phases. First, it is desirable to reduce the total number of engine parts, particularly the more expensive ones, and also attempt to secure as few different components as possible.

Next, we must consider the design of each part from the standpoint of machining and material costs, and then study the arrangement of the design with a view toward facilitating assembly and maintenance. We must not look for marked cost reductions by means of lowering quality, because this method is both impractical and dangerous.

Now, let us consider for a moment how far we can go in this direction with any existing design. At the outset, it is possible to substitute battery ignition for magnetos, and probably reduce the cost of some of the other auxiliaries which are purchased ordinarily by the engine manufacturer. But, that does not go far enough, for we must actually reduce the number of engine parts.

There is little opportunity to eliminate parts in the conventional four-cycle engine, regardless of its form or arrangement of cylinders. The major parts of all engines in this category are essential for proper functioning, and simplification must be confined to the less important details. While the ultimate in refinement and simplification most assuredly has not been reached in most small aircraft engines existing today, it is quite evident that we cannot go much farther along such a specially prescribed course.

Attention, therefore, must be turned to possible unconventional constructions which—by virtue of their arrangement—will require fewer working parts, or else consider the two-cycle forms.

There is little chance of overlooking any worth-while possibility if we neglect the first-mentioned class of design, since almost every conceivable arrangement has appeared at some time or other and, for sufficient reasons, has not survived. However, the two-cycle engine, in some of its various forms, is inherently more simple than the four-cycle engine as regards mechanical construction, and for this reason deserves more than passing consideration.

The two-cycle type has been produced in a variety of forms for aircraft use, but it generally failed to keep pace with its four-cycle rival for the very reasons that it was abandoned almost completely for other purposes. A power stroke in each cylinder for every revolution of the crankshaft did not produce twice the horsepower of the four-cycle engine of equal displacement which

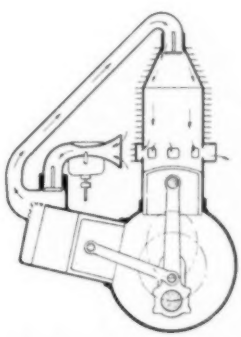


Fig. 8. The first two-cycle engine invented by Sir Dugald Clerk. Note the articulated rod and bypass.

XUM

some of its adherents were hopefully striving to attain.

The more common two- and three-port types, with crankcase compression, suffered seriously from poor scavenging and low volumetric efficiency, and this resulted in very little increase in output as compared to a four-cycle engine of equal size. These engines were exceedingly wasteful of fuel and oil, and when specific weight was taken into account, there remained little to justify their existence aside from structural simplicity.

Since it is the aim to secure an engine having the fewest possible number of parts, is it going to be practicable to revive the two-cycle principle for aircraft use? I refrain from answering this question in a positive manner, because some inventive genius may discover a new way to overcome the aforementioned difficulties. It may be possible to throw more light on the subject, however, by further discussion of what these problems really mean.

It now appears that, in years gone by, engineers and inventors permitted the mechanical simplicity of the two-cycle engine to dominate their interest, and thus partly screen their attention from some of the problems of a more vital character. While poor scavenging and low volumetric efficiency were recognized, designers were prone to deal with these undesirable features only by mechanical means.

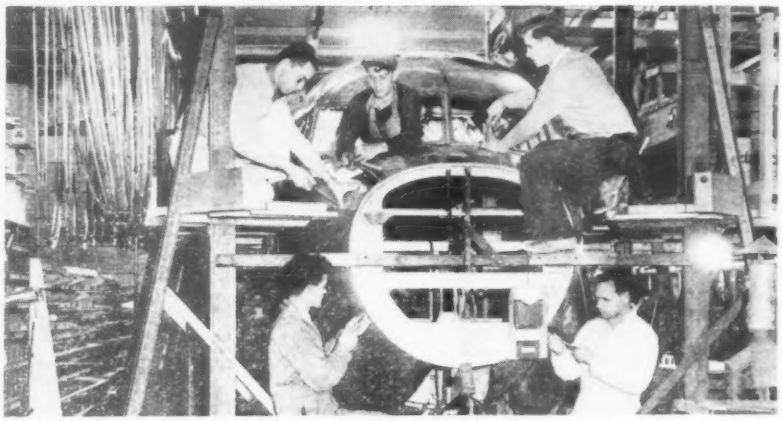
Starting with the simplest form of prime mover—the two-port, two-stroke engine employing crankcase compression—attempts were made to overcome these difficulties by such minor complications as the addition of ports. As a result, two-cycle engines have appeared in the three-port, four-port, and six-port types. Other variations of this class, in which the gas was not compressed in the crankcase, but still on the under-side of the piston, have appeared in what has been termed the cross-head and ball-slide types.

Other inventors attempted to secure an inlet charging pressure for better scavenging by building engines of the differential-piston type. These twin-bore cylinders arranged for gas transfer in several ways. Some employed crankcase compression to supercharge; others for exhaust withdrawal. In the tube-piston type, crankcase compression was not used; the same being true of the designs in which the charging was done in another cylinder.

Double-piston designs have shown more promise than any of the types referred to thus far. The U-types, in which a combustion space is common to adjacent bores and with pistons operating usually from the same crank-pin, show vastly superior scavenging because the gas is permitted to flow substantially in one direction, or from end to end. This condition is likewise true in the opposed-piston designs, in which two pistons travel always in opposite directions in each cylinder, and

(Continued on page 322)

The Douglas Plant is to Expand



An assembling department in the Douglas Aircraft Company's plant.

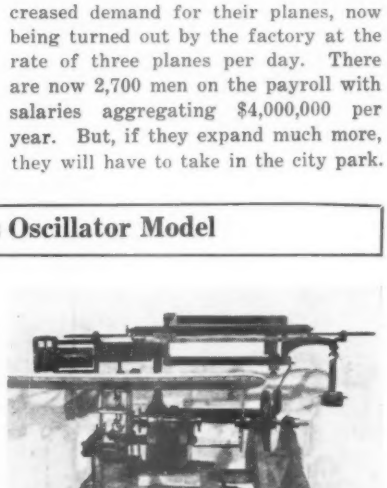
IF THE citizens of Santa Monica, Calif., decide to sell a portion of their public park, the Douglas Aircraft Company will soon be the largest aircraft factory in the world.

The company is now planning to expand the building and grounds to twice their present size to meet the increased demand for their planes, now being turned out by the factory at the rate of three planes per day. There are now 2,700 men on the payroll with salaries aggregating $4,000,000 per year. But, if they expand much more, they will have to take in the city park.

Here Is Nemeth's Oscillator Model

LAST month, we published a chart of the Nemeth Levitator performance which showed a remarkable lifting ability. This month we are fortunate enough to show photographs of this direct-lift device on which the tests were made. Its further development, therefore, will be followed with much interest.

Mr. Nemeth, a Chicago pioneer in aviation, has spent much time, money and work along highly original lines and is to be commended for the showing that he has made in a virgin field of endeavor. This is real pioneering, a long way off the beaten track, and when the patent situation so permits, we will give our readers the full details on how the device works and all about it.



The oscillator under test on a sensitive balance.

An elevation of the Nemeth oscillating levitator.

Yessir! A Hovering Airplane!

by EMORY F. SCOTT

A new type of direct-lift aircraft in which a high velocity air-stream creates positive and negative lifting pressures on a circular wing.

THEORY, a two-thousand-pound airplane, capable of carrying a pay load of one ton.

"Impossible!" you say, considering the fact that there has never been an airplane perfected, yet, that would carry much more than about one-third of its actual weight in useful load.

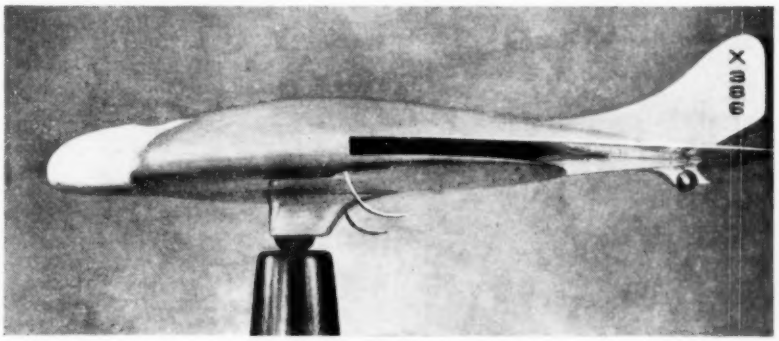
Lieut. L. T. Harris is a disabled World War officer. Having served in the engineering section of the U. S. Army, his hobby naturally centered around mechanical things, and most of all—airplanes.

The result that grew out of his aeronautical research could hardly be called a "dream-ship." Working in his spare time, Lieut. Harris, in the past five years, has built four models of his hovering ship. Two of these were ten-foot models, using one-half h.p. motors. Each model, with this power plant, has been capable of sustained flight. The accompanying illustrations represent his fourth and latest improvement.

This development inaugurates two distinct innovations. The first of these being a novel form of lift and directional propulsion. The second embraces an original principle for the control of aircraft. However, the primary object of this invention is to provide a practical aircraft, wherein lift may be secured, either wholly or partially independent of directional movement.

Fig. 1, of the schematic drawings, shows a side view of the one- or two-place ship. A view of the front is shown in Fig. 3, illustrating the wing's retractable leading edge. In sketch 4, the cockpit is added for a top view of No. 3.

Roughly speaking, the improved aircraft as shown, consists of a circular airfoil (1), arranged with its leading edge in the path of and at a suitable angle of attack to a mechanically generated, high-velocity air-stream, whereby there is produced a positive pressure on the bottom surface and a negative pressure on the top surface of the airfoil.



A model of the hovering airplane.

This airfoil is dished upwardly to secure the desired angle of attack to the air-stream. A radial motor (18) drives the centrifugal blower (9), drawing the air from above and discharging it radially.

The lower part or framework is covered, forming the lower wing (5) which is also a circular airfoil. Being conical in shape, this provides the equivalent of dihedral. These two members are secured by uniformly placed struts or tie bars both inwardly and along the edges.

At the forepart or leading edge of these airfoils, the cockpit (14) is built into both members. It is, however, a continuation or major part of the frame, merely being faired to the upper airfoil.

A longitudinal frame or backbone extends from the cockpit to the tail assembly. The regular tail arrangement is used, (3) elevators, (4) rudder, and (4) fin. This is all a part of and faired out (2) from the upper wing. Tail wheel (17) joins where the backbone and fin coincide. The ailerons (10), peculiar to other craft, only operate in a downward motion. Their upward swing terminates at the under side of the lower wing, flush with its surface.

The single type of landing wheel is used (16), supporting skids being placed at each side under the lower wing to maintain an even keel when the ship is in a neutral position. For the transport model, a cabin may be suspended beneath the lower wing, using the regular split type landing-gear.

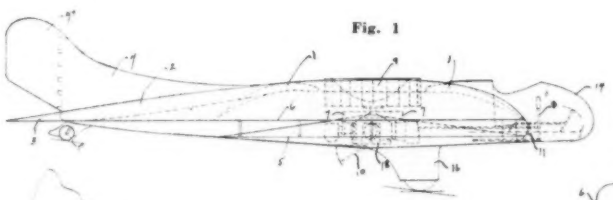
In addition to the ailerons, the craft may be controlled laterally by variations in the relation between the airfoil and the mechanically generated air-stream. In other words, blower (9) and power plant (18) are mounted on a shaft (7) which allows this assembly to oscillate laterally, independent of the ship.

This movement synchronized with the ailerons is to be controlled by the stick. Due to the even pull from above, this feature also tends to stabilize the ship in fluctuating air currents. A much clearer conception of this may be had in Fig. 2. Fig. 2 also illustrates to a better advantage the aileron action and lower wing construction.

So much for construction and power plant location. The theory has been explained and now for more detail as to its operation.

As the air is drawn from above by the blower it has an even degree of pressure or discharge to the surrounding 360 degrees of the atmosphere when forced between the two airfoils. Space between the two airfoils being open for the full 360 degrees, this force tends to have a lifting action such as a wing encounters when speeding through the air. Thus, without forward motion,

Fig. 1



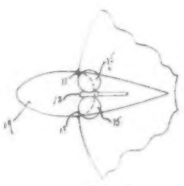


Fig. 4

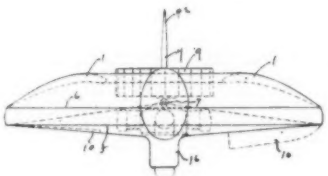


Fig. 2

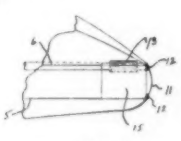


Fig. 3

Schematic drawings of the Harris plane.

the ship rises. In addition to this the centrifugal blower, due to its sucking action, also produces a lifting force in itself. Here we have the combined lifting force of the two.

To utilize this mechanism for a directional movement, we have only to appropriately unbalance the reactions resulting from discharge of the air-stream into the surrounding atmosphere.

This may be conveniently accomplished by providing a closure (11), Fig. 3, effective to close all or a portion of the forward 180 degrees of the circumferential opening between the upper and lower wings. This not only produces an unbalanced relation by retaining only those forces which by acting on the atmosphere produce reacting forces, the result of which propels the craft in a forward direction.

It also provides a positive abutment, relatively immovable, against which the air-stream reacts throughout the forward 180 degrees, thus producing an additional resultant force of considerable magnitude which functions to propel the craft forward.

The closure (11) we will call a retractable leading edge. It is of flexible metallic strips arranged so that it may be projected or retracted from its coiled position in housing (15). The retractable edges slide in grooves (12) which are secured to the adjacent edges of the upper and lower wings at their forward circumferences. A worm gear (13), driven by a shaft from the power plant, operates the retractable edges.

It has been necessary, in some cases, to use adjustable vanes between the wings in order to balance the irregularities of skin friction as compared to power reaction. Where the blower tended to move the ship on its vertical axis in a mutual direction due to skin friction, the power reaction or torque offset this force. This retains all of the advantages of the Autogiro.

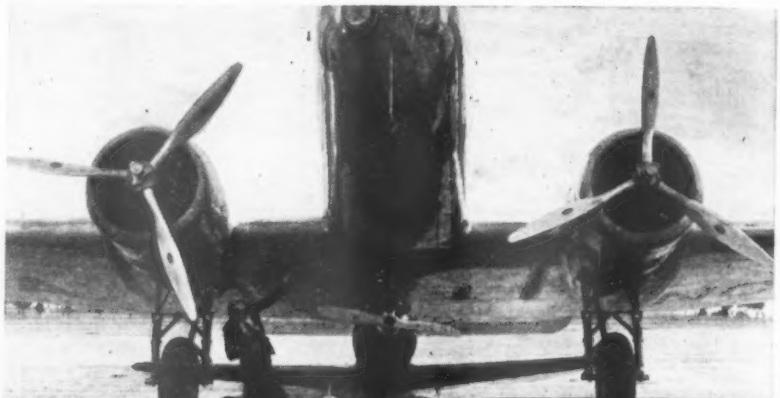
One of the latest improvements is an internal rudder which acts in conjunction with the external rudder. The internal rudder attacks the air currents in a neutral position as they come from the blower blades. This arrangement gives control about the vertical axis in hovering or stationary flight and also tends to balance the forces between skin friction and power reaction.

A surprising feature is the method of lateral control. This control is established due to the fact that the upper airfoil strongly resists any changes in its normal relation to the air-stream issuing from the blower and tends to immediately resume such normal relation following any forced change through manipulation of the stick.

This design would indicate much less storage space needed as compared to the conventional type ship of like wing area. All flights of these models have been witnessed by pilots and engineers who have evidenced approval of its possibilities.

END

The Pigmy and the Giant Meet



This is an extreme in airplanes, the mammoth transport plane and the miniature sportplane.

EDDIE ELLENBAUGH, whose real job is keeping a golf course in Santa Monica, Calif., built a lightplane for himself. Just to show that it really was a lightplane, he placed it in front of a giant two-motored transport. It will be seen that the wing-span of the baby plane is just about equal to the landing-wheel tread of the transport.

This little low-wing monoplane has a wing-span of about sixteen feet and has attained a speed of 140 m.p.h. Eddie says that he did most of the work in the living room of his home. From all appearances, the landing-gear is of the retractable type, although we have no definite dope on this subject.

English Build a New Sportplane

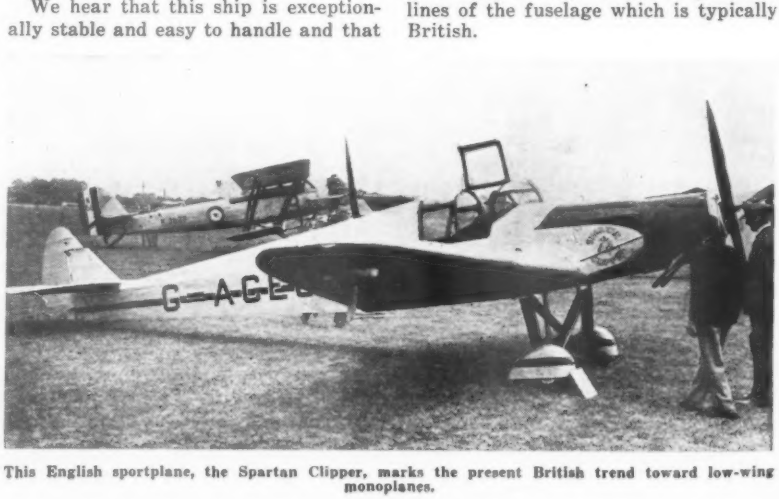
THE Spartan Clipper is a new addition to English lightplanes. It is an attractive 2-seater for the private owner that is to be sold for about $3,250 which, as we view things in this country, is quite a high price for a ship of this type.

It is powered with a 75 h.p. engine of the radial type and is said to cruise about 95 m.p.h. This low-wing lightplane is well fitted up with a complete complement of instruments, full vision cabin and everything that is generally listed for the larger plane, which probably accounts for its high price.

We hear that this ship is exceptionally stable and easy to handle and that the 75 h.p. engine (name unknown) is able to provide a sufficient surplus of power for rapid climbing and maneuvering.

In one sense, this ship is representative of a change in British airplane design policy. For many years, the great majority of English planes were of the biplane type, but during the past two years, the monoplane is becoming more and more prominent both in sportplanes and transport types.

It is interesting to watch this evolution in a national preference of which the Spartan Clipper is an example. One marked feature is the long slender lines of the fuselage which is typically British.



This English sportplane, the Spartan Clipper, marks the present British trend toward low-wing monoplanes.

The N.A.C.A. High-Speed Tunnel

by S. R. WINTERS

A description of the new tunnel employed by the National Advisory Committee on Aeronautics that can provide airspeeds up to the speed of sound. This tunnel may open many important discoveries for super-plane speeds of the future.

SEVERAL things make this latest high-speed wind-tunnel of the National Advisory Committee for Aeronautics superior to previous devices.

The diameter of the tunnel is larger; the flow past the model is relatively nonturbulent, because the air-stream in the tunnel throat is composed only of air taken directly from the atmosphere. In addition, the models extend through the walls and are supported outside the air-stream, thus avoiding the effects of support interference.

In general, the high-speed wind-tunnel resembles the form of most venturi-type wind-tunnels. Naturally since it differs in its use there are some major differences in its characteristics and equipment. Its outstanding features are the large speed range which extends up to the velocity of sound when the model is not in the tunnel, the drive system and the automatic-recording balance which is used to measure the forces.

The arrangement is as follows: compressed air from the variable-density wind-tunnel is piped to the high-pressure section and discharged by way of an annular nozzle. The spray from this nozzle causes a flow of air from the atmosphere through the lower portion of the tunnel, where the model rests on a photo-recording balance. The atmospheric air mixes with the high-pressure air in the diffuser which carries the air to the exterior through the roof of the building.

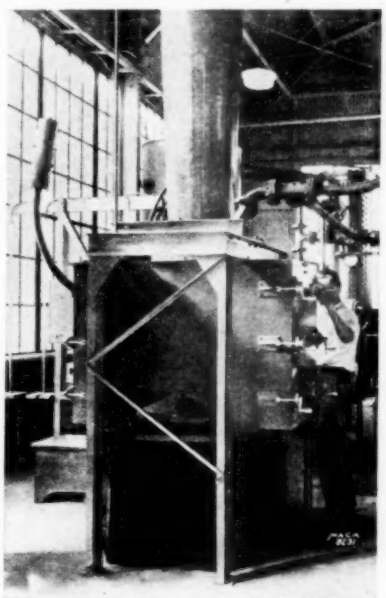
The balance and the lower portion of the tunnel are encased in an airtight wooden chamber which is upheld by a metal framework fixed securely to the floor of the building. By the removal of two opposite sides of the chamber, access to the tunnel and balance is obtained. To make it easier to mount the model, one-half of the test section is removable.

The entrance cone measures 17.67 inches long and 11 inches in diameter at the point where it joins the test section. To prevent twisting of the air-stream at the entrance cone, six vanes which extend from the floor to the plane of the mouth of the entrance cones are provided.

The test section is 7 inches long and recedes slightly to lessen the axial static-pressure gradient. The angle formed by the walls of the exit cone is 4.6°; the part tapered at this angle is 13 5/16 inches and finished in a sharp step just below the annular nozzle. The diffuser is 19 feet 10 inches long and the included angle between diametrically opposite elements is 4.8°.

Compressed air discharged through an annular nozzle around the tunnel downstream from the test section motivates a flow of air from the atmosphere through the test section of the tunnel where the models are placed. Both the nozzle and the high-pressure chamber are of cast steel. The opening of the nozzle is ring-like, and at its smallest is 0.06 in. A divergent portion of it is 1 15/16 inches long. The total angle of divergence is 11.1°.

In studying the tunnel characteristics, we find that the dynamic-pressure variation across the tunnel, along the quarter chord position of the model is not as much as ±0.5 percent. The direction variation of the air is believed to be less than ±¼°.



General view of the N.A.C.A. high-speed wind-tunnel. It differs greatly from the usual tunnels in both size and design.

Because of the uncertainty of the value of the power input, it is hard to fix a figure for the energy ratio. However, for the sake of comparison, the power input is considered as the rate of work due to an adiabatic expansion of the high-pressure air from the pressure in the reservoir to atmospheric pressure. Thus, the quotient of the kinetic energy of the air that goes through the test section in a unit time divided by the power due to adiabatic expansion of the high-pressure air, is considered to be the energy ratio.

The balance, which measures the large range of forces due to the wide speed range over which tests are made, must be automatic in its recording, because the allowable time for observations is brief. By multiplication and recording of the deflection of steel springs to which the forces are transmitted, the balance measures the lift, drag and pitching moment.

The balance is made up of these essentials: a cast-iron cradle in which is held a yoke to which the model is attached, the necessary linkages for transmitting the forces to the springs, and a camera for multiplying and recording the deflections of the springs. The cradle of the balance extends half way around the tunnel and the yoke it contains is rotable.

Three vertical rods support the cradle, one of these rods having direct connection with one of the balance springs. A fork-shaped lever above the cradle joins with the other two rods. With a support at the center, the other end of the lever is connected to another of the balance springs. A pair of rods, one on both sides of the cradle and joined through a truss to the third balance spring, maintain the horizontal movement.

The horizontal or lift forces are transmitted from the balance cradle to the rear spring of the balance, by way of the lift linkage. The moment linkages and the drag are inter-acting. The drag is the algebraic sum of the forces in the three vertical supports. The forward supports are parallel to the tunnel axis and their axes are in a vertical plane which passes through the axis of the tunnel and the quarter-chord line of the models.

The forces in these supports are passed through the fork which is held on the balance frame over the cradle, to the deflecting spring. The forces in these linkages will not add to the moment, if the moments are taken about the line joining the intersection of the horizontal and vertical linkages on either side of the tunnel. The moment is given directly by the force in the rear support which is joined to another deflecting spring.

The balance linkages are connected by Emery knife-edges which are thin steel deflecting strips joining the members. Except for a variance in size the three balance springs are practically the same.

The size differs in accordance with the magnitude of the forces to be measured. They are cantilever beams of rectangular cross section, and of heat-treated steel. They have a short length of reduced thickness to localize the deflections. Deflections corresponding to the largest forces encountered are of

the order of 0.005 inch due to the particular thickness of the springs.

There are three requisites for the recording system. It must record the forces automatically, it must provide a large multiplication and must provide a senstitivity control. By sensitivity control is meant some easy means of increasing the multiplication so that accuracy may be kept when the forces are comparatively small. The arrangement of the recording system is particularly interesting.

Long arms are fastened to the balance springs. A bushing, in which a stylus is fitted, is fastened to the ends of these arms. The multiplication of the beam movement is changed by rotation of the bushing. A pivoted mirror, contacting the stylus, is operated by the movement of the balance springs. Dashpots are connected to the spring arms to provide dampness.

Provision is made for a source of light and lenses so that mirrors can reflect light to a moving film. A small electric motor drives the film through a train of gears gaged for three speed variations. Control of the source light and the film drive is from the outside of the balance and the tunnel chamber.

Mounted in jaws at the ends of the yoke, the model is dowelled so that the line connecting the intersections of the horizontal and vertical linkages corresponds exactly with the quarter-board axis of the model. Through intersection of the horizontal and vertical linkages, the angle of attack is changed. The various angles of the yoke are set by means of a pin which projects from the yoke into holes in the graduated quadrant.

The model is placed across the tunnel and through holes in the tunnel wall. A particular kind of end plate covers each of these holes to reduce the flow into the tunnel from the dead-air space and to lessen interference with the air-flow. These circular end plates are made of a thin brass and they fit into recesses in the tunnel wall just outside the edges of the holes.

Because they are pliable, they can bend as the angle of attack varies and still maintain the contour of the walls. A 1/16-inch clearance between the model and end plates is accomplished by holes cut in the end plates. Six U-shaped pieces fasten the end plates securely. One side of each piece is soldered to the end plate and a screw projecting from the other side turns down against a ledge on the outside wall of the tunnel.

To turn the end plates with the model, as the angle of attack is changed, the screws in the U-shaped pieces are loosened. In case the model contacts the end plates during a trial a signal is given by a specially provided light.

The following is a typical airfoil test. Standard airfoils, 2-inch chord, are made of metal—preferably steel. A generating machine working from a sixfold templet makes them. Machined flat at the ends, the airfoil are drilled from a jig to certify correct mounting on the balance.

After mounting the airfoil in the balance the pivoted yoke is used to set the angle of attack. The valve in the high-pressure air duct is opened wide, and when the mercury manometer shows that conditions are steady, observations are taken. Throttling will obtain lower speeds.

The entire speed range is covered with interruptions for recording zeros. The same procedure is repeated for the various angles of attacks. One tank of air serves for a number of angles of attack, dependent on the number of speeds for which observations are made. It requires about 12 minutes to test an airfoil at one engle of attack over the entire speed range.

As previously mentioned, the photographic record evaluates the forces and moments, and the deflections shown on the film are measured by a special device. The forces corresponding to these deflections are read from the calibration charts. The data are then put into the standard non-dimensional coefficient form.

The balance used with the N.A.C.A. high-speed tunnel.

It is neither definitely known or understood what effect the tunnel walls have on the aerodynamic characteristics of airfoils tested in this high-speed tunnel. However, it is known that the effect of variations in the form and clearance of the end plates is vastly important and, therefore, the end plates are adjusted with greatest care. It is believed that the data may be directly applied in practical design problems as airfoil data for infinite aspect ratio.

To foretell best the performance of a propeller depends for the most part on being able to determine the aerodynamic characteristics of the airfoil sections which are used as the propeller blade sections. In previous tests made in conventional wind-tunnels the effects of compressibility have been usually disregarded because there was so little of information upon which to base a valid correction of this effect. So tests were made with six commonly-used propeller airfoils at high speeds to provide more accurate data on which the design of propellers could be based.

Sections of 3 of the airfoils used were based on the R.A.F. 6 section and 3 have sections based on the Clark Y section. The thickness of the airfoil is the chief variable in each group of the three. It was proven that Clark Y airfoil sections are superior to R.A.F. 6 airfoil sections for propeller applications, except for high-pitch propellers operating at low values of V/nD. The thin sections were found to be better than thick sections for propellers operating at great speeds.

In studying the effects of compressibility it was found that as the speed of the air flowing past an airfoil is increased the lift, drag and moment coefficients undergo a small numerical increase which continues until a compressibility burble occurs. As the speed is further increased the breakdown of the flow corresponding to the compressibility burble is evidenced by a drop in the lift coefficient, and a rapid increase in the drag coefficient.

The speed at which the compressibility burble occurs depends on the angle of attack and the thickness of the airflow, and increasing either of these causes the compressibility burble to occur at lower speeds.

Propeller characteristics as computed from data and measured propeller characteristics cannot be expected to agree exactly in view of the fact that measured propeller characterstics are effected by the hub drag and propeller-body interaction. Past experience, however, indicates that the total interference effect is small because the effects of the hub drag and the added drag of the body due to slip-stream have a tendency to offset the effects of the body on the propeller characteristics, so that a comparison of the computed and measured propeller characteristics may be expected to yield information of some value.

The major difference between the computed and the measured characteristics is in the value of the thrust coefficient when the tip speed is equal to 0.9Vc. This difference causes a great reduction in the efficiency of the propeller as deduced from the airfoil data. It would appear that the greatest efficiency from the computed characteristics begins to fall off at a lower tip speed than the same efficiency from the measured characteristics.

The foremost factors constituting the difference are in all probability Reynolds Number differences and a constriction of the test section of the high-speed tunnel when the model is in position. In England tests of model propellers have shown a drop in efficiency at speeds lower than that shown by the full-scale tests. The difference between the model and full-scale tests has been attributed to Reynolds Number differences. A thorough investigation of the causes of discrepancy would require considerable more experiment.

In conclusion, it is said that although the Reynolds Numbers at which these tests were conducted are low, the results indicate that errors may be expected in the estimated design loads for airplanes which reach speeds such as those attained by diving bombers.

High-Lights and Side-Lights

by M. A. RODDY

Pertinent remarks on the recent doings of men and women engaged in the aeronautic industry and their most noteworthy achievements.

AIR VIEWS: Remember about my telling you, a few issues ago, that there was considerable "heat" in the Air Commerce Bureau, headed by Eugene Vidal? Well the heat has developed into an explosion and T. B. Bourne, I. D. Marshall, L. C. Elliott and G. C. Miller have been removed as district managers of the aeronautics branch with more to follow.

Removal of these technical experts, to make way for political appointees, was accomplished in a secret order issued on February 5. It is also reliably reported that the powers that be, of a western state, have a candidate for the position of chief engineer of airway development and construction. How about it, Mr. Vidal?

* * *

PRESIDENT Franklin D. Roosevelt recently conferred with House and Senate leaders relative to the speedy enactment of a bill to give the Interstate Commerce Commission immediate control of payments to airline operators. Representative Donald C. Dobbins, of the House Post Office and Post Roads Committee, has presented legislation that would raise present rate limitations from 33½c to 40c a mile for each 300-lb. load or less carried by planes. This would increase the route mileage to 32,000 miles and would also increase schedules to an aggregate of 45 million miles a year.

Of special interest to airline pilots, mechanics and workers on the airlines, is a provision of the bill which holds wages to the schedule set by the National Labor Board with permission to go higher by bargaining. Pending enactment of permanent legislation, Postmaster General James A. Farley extended 7 air-mail contracts which expired March 1.

* * *

DIRIGIBLES: Certain military officials are of the opinion that the recent destruction of the Macon has, at least temporarily, sealed the fate of that type of craft in service. Army and Navy staffs are at present reorganizing their respective air services with dirigibles OUT. Maybe you would like to know that one of the two men lost in the Macon crash was the radio operator, Ernest Edwin Dailey, who stood by and flashed the location of the disaster saving his comrades.

* * *

COLONEL Clarence M. Young, former assistant secretary of commerce for air and Pacific division manager for the Pan American Airways, is busy with organization work necessitated by the immediate pending operation of ocean schedules. Long range flight are now being made for training purposes.

* * *

BRITAIN and France are rushing planes for ocean air supremacy and France has just completed test flights of the Lieutenant de Vaisseau, a huge seaplane capable of carrying 84 passengers and costing $1,647,500.

Wiley Post is still in the limelight.

THE big international air race around South America and back, that was being sponsored by Elliott Roosevelt and General Johnson, has been postponed until the spring of 1936. In the meantime, the French Aeronautical Club, with the support of the International Aeronautic Federation, is preparing regulations for a proposed air race around the world which will be held in the spring of 1937.

* * *

AVIATION operators in the east are much opposed to the recent bill introduced by Senator A. Spencer Feld of New York City, which would create a permanent State Aviation Commission with powers to TAX airports, flying schools, manufacturers, planes and pilots claiming that such a board would increase expenses of a harassed industry, while merely duplicating federal regulations.

* * *

EXPERIMENTS are being conducted by the Federal government on blind flying equipment to be installed on the midcontinental airway between Los Angeles and New York as an aid to future six-hour transcontinental passenger service through the substratosphere, other high points thereabouts.

Major R. W. Schroeder, chief of the Commerce Department's airline inspection branch and former holder of the world's altitude record, has been studying stratosphere flights very carefully, as present obstacles include developing a super-charged motor capable of flying between 30,000 and 35,000 feet instead of present levels of 12,000 to 15,000 feet. Altitude pressure effects on passengers must also be eliminated.

* * *

SABOTAGE? "I want the public and my friends to know that I am not trying to alibi because my flight failed. I am going to try again," declared a belligerent Wiley Post at Newark Airport, where he also vehemently denied published charges by him that another pilot had tampered with the engine of the Winnie Mae, causing a subsequent forced landing in the dry bed of Muroc Lake shortly after the start of its recent cross-country stratosphere flight.

Post also added that he had been "bawled out" by TWA officials, because one of the varied newspapers accounts intimated that the one-eyed round the world flyer suspected someone in the employ of TWA, sponsors of the project.

Upon successfully completing his forced landing on the Mojave desert, Post says that he climbed out of his plane and wearing his rubber pressure suit and helmet, hobbled over to a lone automobilist, who had not witnessed his descent and who was busy working upon his stalled car. Post tapped the man on the shoulder who took one frightened look and took it on high, later explaining that he thought Post was a man from Mars.

* * *

FLYING FISH: Officially known as P.16, the "flying fish," which resembles the letter "M" against the sky has been tried out by Italy in the hope of adding a long distance flight mark to the speed and altitude records already held by the National Aviation Corps. Engineers credit the new ship with a speed of 250 miles an hour and a range of 7,500 miles with comfortable cruising at heights above 30,000 feet.

* * *

PRESIDENT ROOSEVELT has been authorized by the Senate Naval Affairs committee to present Distinguished Flying Crosses to Air Marshall Italo Balbo and Gen. Aldo Pellegrini, in recognition for their formation flight of twenty-four planes to Chicago and back to Italy during the Century of Progress.

ESTABLISHING a record, Herbert Sargent, 22, of Jersey City, made a solo flight after but 55 minutes of flying instruction from Eddie A. Schneider, former holder of the junior transcontinental record.

* * *

DURING a recent trip to Chicago, Col. Roscoe Turner stated that he was constructing a 19-ft. plane, capable of flying 400 miles an hour, and which would enable him to fly from Chicago to New York in about one hour and 45 minutes. Present plans also call for the flying colonel to land a giant transport plane some time in May with a parachute in order to prove that large planes can be equipped with 'chutes and landed safely in case of mishap.

* * *

SPEAKING of speed, Leland S. Andrews, American Airlines, accompanied by co-pilot Henry Meyers and G. D. Rayburn, flew the same plane in which Jimmie Doolittle previously had lowered the speed record, to new transcontinental clocking of 11 hours, 34 minutes and 16 seconds for the flight between Los Angeles and Floyd Bennett Field, Brooklyn. However, the honors still remain in the family as Andrews and Doolittle both married sisters while they were in the Army.

* * *

ARCTIC NOTES: Rear Admiral Richard E. Byrd is reported to have assured Sir Charles Bathurst, governor general of New Zealand, that the United States will not claim any land discovered by his expedition. Four hours after the expedition's flagship docked at Dunedin, N. Z., Dr. T. G. Poulter, second in command, and Miss Helen Gray of Iowa were married, arrangements for the wedding having been completed by wireless. Pilot Bernt Balchen is back in New York after an Antarctic trip with the Ellsworth party.

* * *

DID you know that Alger Graham, pilot for the polar flight of Sir Hubert Wilkins in 1927, has only had temporary work since 1933 and is at the present moment employed as a census enumerator for the PWA?

* * *

HANGAR FLYING: H. W. Susott, flying the American Airlines run between Chicago and Washington, and Stewardess Yvonne Lawson have marched down the aisle and said, "I do!" Congratulations and many happy landings.

* * *

ACCORDING to a survey by the Bureau of Air Commerce, there are 775 radio-equipped airplanes in commercial and private operation in the United States. 345 are owned by the scheduled airlines, 246 installed in private planes, 135 in ships used by individual firms, and 49 in craft used for taxi and charter flights.

(*Concluded on page* 324)

The Aero-Sportswoman

by JOAN THOMAS

LADIES and gentlemen: we give you Amelia Earhart. Not because she has flown two oceans and holds a flock of other records of which any flyer might be proud, but first, because she is and has remained friendly, approachable and unspoiled. And secondly, because she has had the courage and intelligence to stay true to her profession.

She has not allowed the adulation of the public, the glamour of publicity, or the false glitter of would-be promotional schemes entice her into any act that would cheapen her accomplishments, or divert her from her chosen field. She has not endorsed anyone's cigarettes, canned rabbit (and that is not a joke, the rabbit was one of her first offers!) or posed for any cold cream ads; nor did she embark on a vaudeville tour, or listen to the siren voices of Hollywood.

After that first Atlantic flight in the *Friendship* with Stutz and Gordon, when she was hailed as "Lady Lindy," showered with honors and féted by the governments of two continents . . . none knew better than she, how little she had done to deserve it. She tried to say so, but the world loves a modest hero. There was only one thing to do . . . to train herself and to make a record that would be worthy of the fame that had been thrust upon her. She spent hundreds and hundreds of hours in the air to perfect her skill in flying; then took a course in public speaking, so that she might be better prepared to help promote interest in aviation through her contacts on the lecture platform.

And it's *hats off* to this amazing girl who so magnificently achieved her goal in her solo-Atlantic flight, but with the true spirit of the explorer and pioneer, was not content even then to rest on her laurels. The Pacific flight is not only one more proof of the skill and courage of this famous flyer, but a dramatic demonstration of the safety and dependability of aircraft.

However, we do not wish to recount her achievements or to try to evaluate their effect on public-opinion toward aviation, but to pay tribute to Amelia Earhart, herself. The AERO-SPORTSWOMAN feels that it is a signal honor to all women, that one who has achieved such distinction can meet it so gracefully.

May we ask (before we are accused of any wide-eyed hero-worship) have you heard her on the lecture platform? We have . . . several times and are more impressed each time. She has such a friendly, informal way, such a keen sense of humor and such *expressive* hands. The only other person we know who can capture an audience in quite the same way, is Schuman-Heink. It doesn't matter whether the beloved diva can sing any more or not, all she has to do is hold out her hands

Miss Gayle Christensen, just before the takeoff.

and give that funny little chuckle of hers and the audience is at her feet. In somewhat the same way Miss Earhart tells how you pull a little gadget here and another little gadget there—and her audience has a vivid picture of just what she means, or think they do—and love it!

We had an appointment with A.E. after her recent lecture in Chicago, which gave us an opportunity to see "public curiosity" from the other side of the looking-glass, as it were. We have always felt sorry for famous people who must be subjected to such demonstrations. And while we have never criticized those who are brusque, annoyed, or haughtily aloof, we want to commend Amelia for her friendliness and sincere appreciation for the courtesy it implies. Not once did she refuse to shake hands, autograph a program, or answer a question. It was only the heroic work of the committee that rescued her from the enthusiasm of her admirers.

That friendly, easy manner is not just a public pose; she is just the same in a small group or with one alone. Quietly reserved, yet keenly alert and intense in her reactions, she is delightfully frank in her opinions of certain organizations and types of aviation enthusiasts, but equally reticent in making personal remarks. She is never patronizing or condescending—either by word or gesture—which we believe is the final test of the thoroughbred.

Before we started to fly we prided ourselves on being extremely tolerant of anyone's ideas and actions, but there are so few women pilots, we will admit that we have become jealous for their reputations as women, as well as flyers. So it is with a deep sense of gratitude that we pay tribute to Amelia Earhart, who has added *poise* and *dignity* to achievement.

* * *

We said once, and we would like to repeat, that half the fun of conduct-

(*Concluded on page* 332)

College Flyers Organize

A NATIONAL intercollegiate aviation association was organized at Washington, D. C., in December to put competitive flying activities between colleges in a class with football, baseball, and other major sports. Delegates from most of the leading universities were present.

There are 150 American colleges in which some form of aeronautical activity is held. It is hoped that all of these colleges can get together in a national intercollegiate flying meet which it is tentatively planned to hold each June. William D. Strohmeir, secretary of the Amherst Flying Club, was made chairman of the committee which will work out details of the plans with the National Aeronautic Association. The program at the annual meet will include such events as bomb dropping, dead-stick landings, and precision flying, but will not permit any dangerous contests.

The showing a club makes in this meet, together with its record for the year, will determine the award of the Loening Intercollegiate flying trophy.

The other points on which the delegates decided to build their program are a college aviation conference to be held in Washington each year; an undergraduate committee to co-ordinate college flying activities with the N.A.A.; and formation of an intercollegiate chapter of the N.A.A.

The University of Minnesota has invited the organization to hold the first meet at Minneapolis.

Attention! Model Builders!

MANY of you fellows like to build models of the most modern of modern planes. Others like to build only the wartime Spads, Fokkers and so forth. But, during the past few months, another group has made itself known—modelists who are interested in the building of pre-war models, Jennies, Curtiss Tripods, Wright Model B's, and similar old veterans that paved the way for modern aviation progress.

Now, J.B.R. was ransacking through his attic the other day and came across a roll of old Jenny JN-4D blueprints, just as they came from the factory in 1918. If you'd like to build a Jenny model, we have the dope. Just let us hear from you on this subject.

Student Meets With Queer Accident

ACCORDING to an International News Service bulletin from Dallas, Texas, **Arthur Glau, a 25-year-old flying student at Dallas Aviation School,** met with an unusual accident.

Glau was struck down and fatally injured by the wing-tip of a Curtiss Condor transport, Chicago bound, as it roared down the runway for the take-off.

Builds Wind-Tunnel Models

The highly finished wind-tunnel model built for test in a home-made wind-tunnel.

CLINTON A. Schmaling, of the Schmaling Aircraft Laboratories, Millerton, N. Y., tells of a series of wind-tunnel models that he and his associates are building for tests. They intend building their own tunnel for smoke and lamp-black testing.

He gives us the accompanying photograph of the forerunner of a series of wind-tunnel models. This particular model is called the Schmaling (S-21) Canuck monoplane. The full-size ship is intended for the A.C.E. (Cirrus III) 95 h.p. engine. The span will be 35'-0". Air-brakes are used on the trailing edge of the center-section.

Some Tests on a Model Rotor Propeller

RAY THOMPSON, Hollywood, Calif., has made a series of interesting tests on Magnus rotors used as propellers which he has described in a letter to POPULAR AVIATION. He has been working on rotors since 1927 and has also investigated combinations of rotors with wings.

The first rotor built by Mr. Thompson was a straight cylinder without taper. According to theory, these cylinders must spin with a skin speed of three times that of the wind velocity to create an area of low pressure on one side and a high pressure area on the opposite side. This creates a resultant thrust at right angles to the breeze.

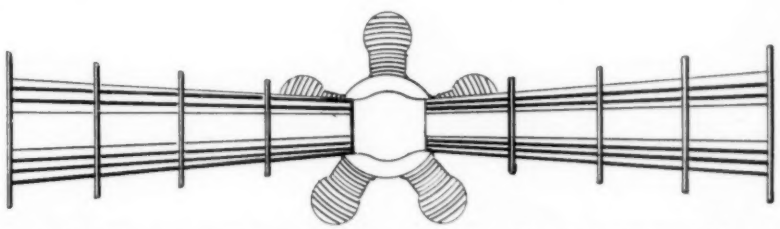
In the tests, a quarter-horsepower electric motor was set on a track to get the necessary movement. A wood propeller was then placed on the motor shaft, the speed of which was 1,750 r.p.m. With a pulley and a piece of string it pulled or lifted a can of sand.

On the first run and with the rotor propeller, no flanges were placed over the ends of the cylinder, the result being a high pitched noise like a whistle, but it pulled one-third more sand than the wood standard type helical propeller. When a flange was placed over the ends of the cylinder, it pulled or lifted three times as much sand at half the speed as the propeller.

No power is required to turn the propeller except for the power lost in the gearing. Unlike a standard type propeller with an airfoil section blade, the pressure is balanced on all sides so far as rotation is concerned. With this prop and a Kinner engine, it will have the same thrust as that developed by a Pratt & Whitney Hornet engine of much greater power.

When developed, this type of propeller has many factors in its favor. First, it can be placed with its axis in a horizontal position to avoid striking the ground and, second, there is no danger connected with it as it does not swing around the engine shaft center like an ordinary propeller. Since it can be laid horizontally, the under-carriage members can be made very short, decreasing the parasitic resistance and giving greater stability when on the ground.

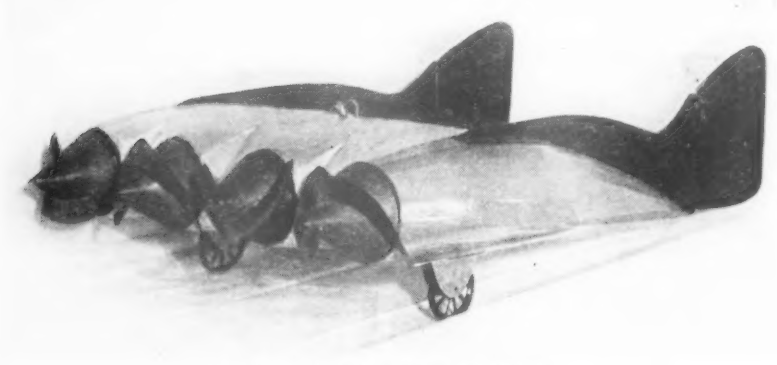
Still another point in the favor of the rotor type propeller is the fact that it can be made less noisy than the revolving blade type and it develops practically no gyrostatic couples or torque that greatly affects the stability of the present type propeller. All of these factors are of sufficient importance to justify intensive development work on the idea of a rotor propeller.



Front view of the rotor propeller gear driven by a radial engine. This rotor revolves around its own axis and not around the crankshaft like the conventional propeller, thus doing away with the dangers of the present propeller.

XUM

A New Flying Wing Plane Appears



This is the Nicholson "all-wing" airplane.

H. A. NICHOLSON, Los Angeles, Calif., a mechanical engineer, has designed a new type of flying-wing or "all-wing" plane with four power-plants. The accompanying photo shows a scale model of this invention which, as will be seen, is about 99 percent wing.

It will be interesting to discover just what results will be obtained by the mutilation of the leading edge of the wing by the power-plants shown. Again, the close proximity of the propellers to the wing will introduce other factors which, at the present moment, are somewhat speculative.

Making a Climb to Ceiling Test

AMONG the tests given to new types of airplanes by the Navy Flight Test Section, at Anacostia, D. C., is a "climb to ceiling" or a climb to the highest point that the plane can reach.

This maneuver is the most complicated one performed during the test routine and the pilot almost has to have sleight-of-hand ability to accomplish all of the operations connected with it. Cloudless, quiet days are necessary.

"In preparation for this test," officers of the Bureau of Aeronautics state, "there will have been installed in the plane two barographs to constantly record the pressure altitude; a statoscope to establish the level flight condition; a thermometer to indicate free air temperature; and in planes with a high ceiling, oxygen equipment for the pilot.

"So equipped, the plane is taken into the air and flown around at a low altitude until the engine is properly regulated and warmed up. The machine is then brought close to the ground, the desired initial climbing speed is attained, the throttle is pushed wide open, and the stopwatch started.

"From then on, the pilot flies at an absolutely steady speed, varied slightly with change of altitude, and records the readings of his various instruments at fixed time intervals. This is continued until the indicated rate of climb is approximately that of service ceiling (100 feet per minute) at which point the climb is stopped, and the descent made to the ground.

"Important data is taken on the way down, the pilot making full power runs at frequent intervals to determine the maximum indicated speeds at each of these altitudes. The statoscope, which indicates the very smallest change of altitude, insures that the plane is neither climbing nor gliding when these latter observations are made.

"A climb to the higher altitudes, such as is common for the small high-powered fighting planes, is about as complicated an operation as one can imagine. To start with, the pilot is bundled up like an Arctic explorer, with heavy fur suit and boots, a mask covering his entire face, and heavy gloves of leather and fur.

"With a warm ground temperature, the early part of the climb is consequently far from being comfortable. The air soon cools, however, and the body feels normal, but then a new complication enters—the air gets thin. The oxygen is turned on for just the normal flow when about 18,000 feet up, and the outlet, a pipe-stem, is held between the teeth.

"From then on the problem is of major proportions, for the pilot must accomplish the following operations continuously: Watch and keep the oxygen flow such as to insure enough to sustain the body, operate the mixture controls of the engine to maintain the maximum engine power, fly at exactly the prescribed speed for the indicated altitudes, constantly observe all instruments, and every two minutes—absolutely on time—record the indications of not less than seven instruments, and all this to be done in a temperature which is probably close to 40 degrees below zero, when fur gloves which make everything thumbs, boots, and fur suit cannot prevent the cold from being appreciated.

Conditioning for the Pilot

AFTER spending many hours aloft, where the air has peculiar attributes all its own, a pilot sometimes experiences difficulty in getting to sleep when he comes in from a trip.

In one instance, the pilot of a ship flying between South America and Miami was about to resign because of insomnia when a unique remedy was discovered. High over the Andes this pilot was accustomed to fly. Breathing air of a different quality to that of a lower altitude, he had accustomed himself to this particular air quality and could not sleep when on the ground.

The odd remedy was found in air conditioning apparatus. A unit was placed in his sleeping room and adjusted to approximate the condition to which he responded most easily. The result was that this pilot has had no more trouble with insomnia. He sleeps easily and awakens refreshed and steady of nerve and eye.

The probable outcome of this experiment will be to air condition the cabin of the ship by maintaining it at the proper air-pressure.

Air Propelled Boat in Service

BETWEEN Budapesth and Vienna, on the Danube River, they are trying out a new type of passenger transfer boat that is driven by an air propeller. It is said that this wind-boat maintains a fast schedule with 16 passengers and has shown remarkable bursts of speed.

It is a double-step hydroplane with its cabin and all exposed parts thoroughly streamlined. Even the hull bears the pumpkin seed outline of streamlining but it would seem that the power-plant could be disposed of in a better manner.

This air propelled boat makes good speed.

About Those "NC" Markings

by

GEORGE C. ADAMS

The Beechcraft Biplane with the NC granted by the Bureau shown on the tail.

THE "NC" markings on an airplane's wings and rudder have a long story behind them.

They are the result of weeks of exhaustive tests by the Bureau of Air Commerce, whose inspectors have gone over the ship as thoroughly as a physician examining a patient with stethoscope and X-ray. They have checked and re-checked the plans and specifications; they have studied the strength of the materials used; they have poked and pried into the innards of the completed plane until they know every inch of it; and, finally, they have taken it aloft and made it demonstrate in actual flight that it could stand the gaff.

Directing this important work is a quiet military-looking man with a ready smile. He is Alfred Victor Verville, designer of two Pulitzer Race winners, for many years engineer in charge of pursuit and racing plane design for the Army Air Corps and a former builder of commercial planes himself. Verville knows his subject from "A" to "Z" and it rests with him to decide whether or not a new plane is awarded an Approved Type Certificate.

When a manufacturer builds a new ship, he must send to the Bureau of Air Commerce its complete drawings, showing the structure, power plant installation, seating arrangement, and all other pertinent information. These drawings indicate what materials are used in the plane's construction down to every bolt, nut, and rivet. They are accompanied by what is known as a "stress-analysis," which shows the strength of every part of the plane and what its margin of safety is. The minimum factor of safety for any aircraft structure is 1.50. This means that its strength is one and one-half times as great as the largest force that it will have to withstand in actual operation.

If these data are satisfactory to the Bureau's Manufacturing Inspection Service at Washington, an inspector is assigned to examine the completed airplane and determine if the construction and workmanship are such as to produce an airworthy machine. If he approves the job, the Bureau issues an Engineering Flight Test authorization. This authorization contains definite instructions as to what points in the plane's performance are to be checked with particular care.

A definite routine is followed on the flight test. Previously, the chief test pilot of the company building the plane will have gone through the specified maneuvers and will have made a report to the Inspector. The stress analysis will have shown what speeds are dangerous for the type of plane and a placard will be placed in view of the pilot bearing the words: DO NOT EXCEED . . . MILES PER HOUR TRUE INDICATED AIRSPEED AT ANY TIME.

The first test will determine the take-off characteristics. The plane must be able to take off within 1,000 feet at sea level in calm air, and must be able to climb at least 300 feet per minute. Multi-engine aircraft must be able to climb from sea level to an altitude of 1,000 feet with one engine dead.

The airplane will then be tested under all loading conditions during landing. Sand ballast is used to replace passengers during these tests, as during all others. The ship must be able to land at a speed not to exceed 65 miles per hour (ships which are not designed to carry passengers may land at 70) with the tail down and power off.

Now the plane must demonstrate that it is longitudinally, laterally, and directionally stable.

The pilot takes it up to a safe altitude, sets the throttle so that the engine is revving up somewhere between its minimum speed and 90 percent of the rated speed and trims the ship with the stabilizer. Then he pulls the stick back until the nose is high above the horizon, and releases it. If the plane is longitudinally stable, the nose will slowly drop until it is below the horizon, then rise above the horizon again, then down, oscillating this way several times until the plane has again assumed normal flight without any assistance from the pilot.

Lateral stability is next tested by putting one wing down and letting go of the stick. After a few oscillations, the plane should right itself of its own accord.

Likewise, the plane is kicked into a turn with the rudder and must come back to flying in a straight line when the rudder is released.

Now, what about the plane's stability at engine speeds above 90 percent? The Bureau prefers a plane to be just as stable here as it is at the lower speeds, but will accept it if it assumes a stable climb without any tendency to stall or fall off on a wing.

In a glide, with power off, the plane must be longitudinally balanced and stable at some speed between 120 and 140 percent of the stalling speed, at sea level. All of these conditions apply to any and all kinds of loads. The ballast is shifted around to similate different seating of passengers or disposal of cargo.

The pilot making the tests notes on his report card three types of stability: neutral, where a plane continues to fly in the disturbed condition, without returning to the former condition; positive, where it returns to the condition from which disturbed; and negative, where it tends to become more and more disturbed.

Next come the spin tests. The plane is loaded, taken up to the desired altitude and the stabilizer set for cruising speed in level flight with this particular load.

Then it is thrown into a spin. After six turns, the pilot places the controls in neutral. With power off, the plane must recover by itself, requiring not more than 1½ additional turns. During the spin, the pilot watches for evidence of back pressure on the stick. This means that the spin is becoming tighter and tighter and approaching a flat spin, and will disqualify it from approval.

Sometimes an airplane won't spin under ordinary conditions. It may take a lot of rough handling to make it go into one—handling that the plane would probably never get in ordinary usage.

Under conditions of this kind, the Bureau is more lenient. The use of elevators and rudder will be permitted to bring the plane out, provided that it can be done in two additional turns.

Big ships are not usually given the spin test. Unless in some particular instance it seems advisable, an air-

XUM

plane of more than 4,000 pounds gross weight is exempt.

During all of these tests the pilot is watching out for signs of flutter, or excessive vibration, or any other undesirable conditions. Most of the inspectors on flight test work have had engineering experience and are experts at finding "bugs" in new jobs.

This ends the flight test. If the Bureau feels that the manufacturer has suitable facilities for constructing airplanes of the type examined, it will then issue the coveted Approved Type Certificate.

But that doesn't end it. The United States is divided into a number of inspection districts with inspectors hot on the job at all times. They bob up at aircraft factories when they are the least expected and make a thorough investigation of the quality of workmanship and materials going into an approved type airplane and of its conformity with the specifications.

Whenever there is an airplane accident, full data is sent to the Manufacturing Inspection Service for Verville and his confreres to determine if it were caused by structural failure or other engineering defect. If such is the case, all airplanes of that type may be immediately grounded.

Verville states, however, that his Service is not operating a police force. Its aim is to make American airplanes the finest and the safest in the world and to do so as far as possible with a minimum of regulation. The airworthiness regulations have been made with the advice and approval of the aeronautical industry itself, and before any new ruling is made, the airplane manufacturers are asked for comments. Verville explained to the writer that he endeavors to make a judicious rather than a literal interpretation of the non-structural requirements, insofar as there is no compromise with safety.

Several times when accidents have revealed that the structure or other engineering features were at fault in a certain make of plane, all the planes of that type have been grounded until suitable alterations were made. This, while highly unconvenient to the owner of the plane and sometimes quite expensive, is part and parcel of the airplane in its present status.

The department, therefore, does not confine its attention to planes under construction but also watches planes of similar type in service, their performance, structural integrity and everything connected with the ship that speaks for safety. It watches the plane and the factory in which it is built, thereby learning much that will later be of benefit to the industry at large. The data thus collected is of enormous value to the engineers and builders of planes throughout the country.

"We are here," he declared "to promote aviation, not to restrict it."

END

Navy Flyer Cited

ENSIGN Matthew G. Seleski, a Naval Reserve pilot, has just been commended by the Secretary of the Navy for his bravery in helping to rescue several persons who had leaped from the burning *S.S. Morro Castle*.

When the ocean liner was reported aflame off the New Jersey coast early one morning last fall, Seleski immediately volunteered his services. Although conditions were anything but favorable for flying, with heavy rainfall and an abnormally low ceiling, he flew out to sea in a landplane and through the murk located the burning hulk.

Passengers were struggling in the water, some of them a good distance from the vessel where they had been swept by the heavy sea. As Seleski circled just a few feet above the towering waves, he saw heads bobbing on the surface.

The flyer immediately directed rescue boats to their assistance. Several times this was repeated, and in each case the survivors were in the last stages of exhaustion and could not have remained alive much longer. Seleski's dauntless courage and keen eyes had meant the difference between life and death.

He was for a time chief pilot and instructor at the Curtiss-Wright-Hadley Airport, at New Brunswick, N. J.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-53

Bolides. Meteoric bodies or bodies from the outer spaces.
Bolometer. An instrument for measuring heat radiation.
Bolt. A cylindrical metal rod, provided with a screw thread at one end and a fixed enlargement or "head" at the other.
Bolt (Aircraft). Special bolts for aircraft of high strength steel and usually made according to the specifications of the Society of Automotive Engineers.
Bolt-circle. A circular centerline passing through the centers of bolts in circular arrangement.
Bolte a' Clapet (French). Valve-box.
Bolts (Carriage). A bolt with a hemi-spherical head and a square shank beneath the head to keep the bolt from turning. Made of soft steel and not suitable for stressing in aircraft. (¼" to 1").
Bolts (S.A.E.). Bolts made to the standards of the Society of Automotive Engineers. Used on automobiles and aircraft. Steel not less than 100,000 pounds tensile strength. Threads are finer than the U.S. Standard thread.
Bolts (Stove). Small bolts (⅛" to ¾") with round or countersunk slotted head. Made of soft material and not for stress.
Bolts (U.S. Standard). The standard bolts for use on general machinery but not suited for aircraft use. Threads are coarse and are flattened ⅛ of the depth of the top of the thread.
Bomb. A hollow shell filled with an explosive bursting charge which is dropped from an airplane by a special device.
Bomb (Demolition). A bomb filled with high explosive and designed for the purpose of demolishing buildings, enemy fortifications, etc.
Bomb (Fragmentation). A bomb that blows its casing into small fragments and scatters them over a wide area. Used against the infantry or massed troops.
Bomber. A plane especially designed for dropping bombs in enemy territory. They are of various sizes and types.
Bomb-rack. A frame or nest for carrying bombs beneath the fuselage or wings of an airplane. It is equipped with release gear by which the bombs can be released singly or together from the body of the plane.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-54

Bomber (Dive). A bombing plane designed to deliver its bombs while diving which insures greater accuracy than in horizontal flight, but which limits the number of bombs discharged in a given time.
Bomb Calorimeter. An instrument for measuring the heat content of a fuel by burning a weighed sample of the fuel in a bomb filled with oxygen. The bomb is immersed in water, and the heat is estimated from the temperature rise of the weighed water.
Bone-black. A paint pigment made from bone charcoal.
Bonnet (Obsolete). The covering over an engine. A hood or cowl.
Booms. Long rods, poles or spars extending from the main wings, to the front or rear for carrying the tail or other control surfaces. Also known as OUTRIGGERS.
Boot. A streamline casing for the landing wheels. Also called "spats."
Bora. A violent dry wind from the north or northeast which blows over the Adriatic Sea.
Boost. To increase or augment.
Booster-magneto.
Bore. (1) The diameter of the cylinder bore or cavity, given in inches or millimeters. (2) To cut a large circular hole.
Bore-stroke Ratio. The relation of the bore to the stroke of an engine.
Boreal Winds. A class of cold winds, generally of a cyclonic origin. The "cold waves" of the United States are essentially boreal winds.
Borealis. See AURORA BOREALIS.
Boreas. (1) In Greek mythology, the God of the Winds. (2) A cold northerly wind or the personification of this wind.
Bosch Magneto. The original high tension magneto with the primary and secondary windings on the relvoving armature. First known as the Sims-Boscg magneto.
Boss. (1) A round or cylindrical projection. (2) A hub.
Bougie (French). Spark-plug.
Bourdon Pressure Gauge. An instrument consisting of a flattened tube bent in part of a circle. Pressure in the interior of the tube tends to straighten it, and in so doing, record the pressure of the gas or liquid by a multiplying mechanism connected with the index hand.

Lands Disintegrating Plane

RIDING a disintegrating plane down from nearly a mile in the air rather than bail out and let it crash into buildings on the ground, was the daring exploit of Captain Harry Manning at Roosevelt Field, N. Y. Captain Manning, who flies as a hobby, is the skipper of the *S.S. Manhattan* and is the hero of enough thrilling rescues on stormy seas to fill a novel.

A few weeks ago, while he was cruising over Long Island in a borrowed plane, the propeller suddenly broke. Immediately the engine began to pound itself to pieces. Manning quickly cut the ignition, but to his dismay the engine did not stop running. A grounding wire had been carried away.

Scalding oil and gasoline were sprayed back into the cockpit from the broken feed lines. The vibration was terrific. The plane was actually being shaken apart.

Manning looked at the densely populated area below him and realized that to desert the plane here might cause the death of persons on the ground. So he stuck with the ship and managed to limp back to Roosevelt Field. The motor was hanging by a single bolt. Other flyers declared that another minute in the air would probably have caused the whole plane to completely disintegrate.

This is about the narrowest escape that we have heard of, and from the worst possible structural failure.

Some New Books of Interest

Lightplane Design

A NEW, revised and enlarged edition of "Lightplane Design" by Walter H. Korff, has just been issued. Several new sections have been added to the book, while the old sections have been revised and brought up-to-date for the 1935 edition.

This 48-page book contains a great deal of useful design information for the amateur plane builder that is presented in a very simple easily understood manner. While dealing with highly technical matters, the author has succeeded in avoiding technicalities in style so that a university education is not necessary for a full understanding of the book's contents.

By chapters, the contents are as follows: Aerodynamics, Parasitic Drag, Stability and Control Surface Design, Landing Gear, Cabin Design, Actual Design Procedure, Detailed Weight Estimates, Balance Drawings, Layout of Tapered Wing, Flying Scale Model, Structural Design, Ten Rules to Follow in Design.

This third edition contains 110 illustrations, charts and diagrams, including wing-section data for eighteen different types of wings.

We heartily recommend this book, not only to intending designers and builders but to all airplane enthusiasts as well.

1935 Henley Formulary Is Issued

THE NEW 1935 edition of "Henley's 20th Century Book of Formulas, Processes and Trade Secrets," enlarged and thoroughly revised to date, has just made its appearance. Formulas and recipes for all sorts of money-making compounds, for all sorts of occupations will be found in profusion.

One of the most useful sections that have been added to this edition is a very complete classified Buyer's List for the information of readers who wish to locate dealers in the various materials employed. It tells just where to get the needed supplies. Other new departments is a section that describes that composition and nature of hundreds of chemical substances in a simple and non-technical manner.

Altogether, there are 10,000 different formulas with a very complete cross-reference index and a section on laboratory methods and processes. It is a book of 800 pages, cloth bound and sells for $4 prepaid.

Books of the recipe and formula type, of which the above is an excellent example, have a real place in every work-shop and laboratory. Many times some little kink, a cleverly devised recipe or rule will save both time and money for the reader. And, again, it opens up an avenue of profit for the home worker who is thus enabled to sell certain products.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-55

Boundary Circulation. Circulation of a fluid about a boundary.

Boundary-surface. The separating surface or boundary between the smooth flow of air or liquid and the turbulent flow or "dead-water."

Bow (obsolete). Forward portion of an aircraft. The nose of the FUSELAGE or NACELLE

Bow-wave. A wave set up by the bow or forward portion of an aircraft in entering still air. It is divided on either side of the BOW and forms an acute angle with the line of travel.

Bower-Barff Process. A process of forming a protective skin of magnetic iron oxide on steel articles by blowing superheated steam over the heated surfaces.

Bow's Notation. A system of lettering stress diagrams for the graphical solution of stresses in trussed structural members. This is the basis of stress analysis in trusses.

Bowditch. A standard book on navigation.

Bowden Controls. A method of controlling engine or plane parts by a wire sliding inside of a flexible metal casing, the casing stiffening the wire and acting as a guide for the wire.

Box-kite. (1) A kite with open box-like surfaces. Also known as HARGRAVES KITE. Generally built with two four-sided box cells. (2) Colloquial name for the old biplanes having vertical interplane surfaces that divided the wing-structure into box-like cells.

Boyle, Robert. Discovered laws governing the compression and expansion of gases in 1662.

Boyle's Law. The pressure of any gas (or air) varies inversely as the pressure, the temperature remaining constant. The density varies directly with the pressure.

Boyle-Gay-Lussac Law. A law connecting the pressure volume and temperature of a gas. The volume multiplied by the pressure is equal to the absolute temperature multiplied by a constant that depends upon the type of gas.

Brace. A structural member for reinforcing a structure against a load.

Bracket. An external member of a structure, or projecting frame, for carrying a load external to the main structure.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-56

Brake. (1) Any device employed for retarding or stopping motion of a body by introducing frictional resistance. (2) A device used in testing engines and motors which applies a known load to the engine or motor.

Brake (Air). (1) A vertical or inclined surface employed for creating air resistance. It is used for bringing airplanes to rest or reducing their velocity when landing. Also known as DEACCELERATORS. (2) Flaps at the trailing edge of an airplane wing which retard the forward motion of the plane and at the same time, contribute some lift. (3) Frictional brakes operated by compressed air in the cylinders of the brake mechanism.

Brake-band. A flexible band surrounding a revolving drum which creates friction when the band is tightened or constructed on the drum.

Brake-drum. A cylindrical body, usually revolving, with its periphery adapted for frictional contact with a band, brake-shoes or similar frictional device.

Brakes (frictional). Braking mechanism employing the principle of mechanical friction between two rubbing surfaces.

Brake-horsepower. The actual HORSEPOWER of an engine or motor as determined by actual test with a BRAKE or DYNAMOMETER. Abbreviation, b.h.p.

Brake-hydraulic. (1) A brake operated by fluid pressure acting on a cylinder connected with the braking mechanism, employed for bringing aircraft to rest or retarding the motion. (2) A fluid operated mechanism for applying a known load to an engine or motor for determining power or torque. The load is produced by forcing the fluid through small passages at high pressure.

Brake (Mechanical). A brake controlled through a system of levers or gears.

Brake (Prony). A device for applying a known load to an engine or motor, consisting of a drum or pulley on the motor or engine shaft and friction blocks or a friction band applied to the outer surface of the drum. The friction between the drum and band tends to carry the assembly around with the shaft, the TORQUE or turning effort being measured through a brake-arm resting on balances or scales.

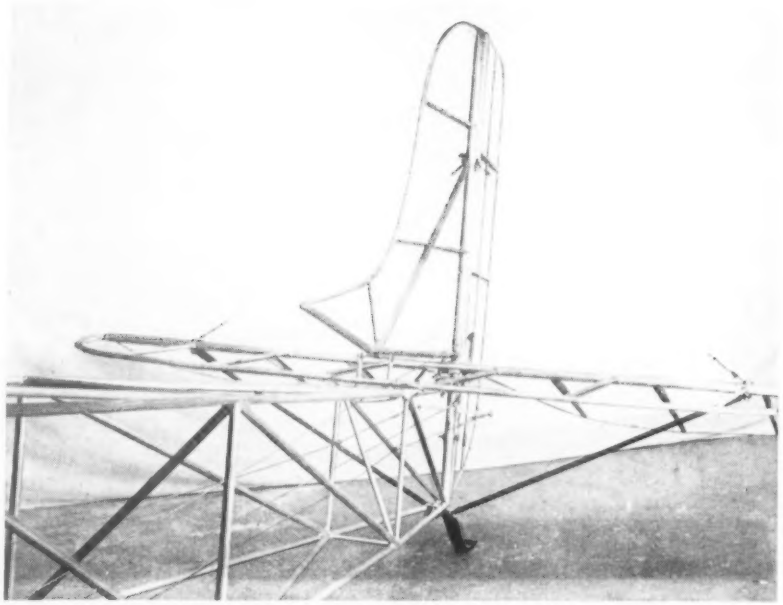
Braking-surface. The area of one frictional surface of a BRAKE.

XUM

Building the Corben Super-Ace

by

O. G. CORBEN



Rear of fuselage with tail-group in place and control wires attached.

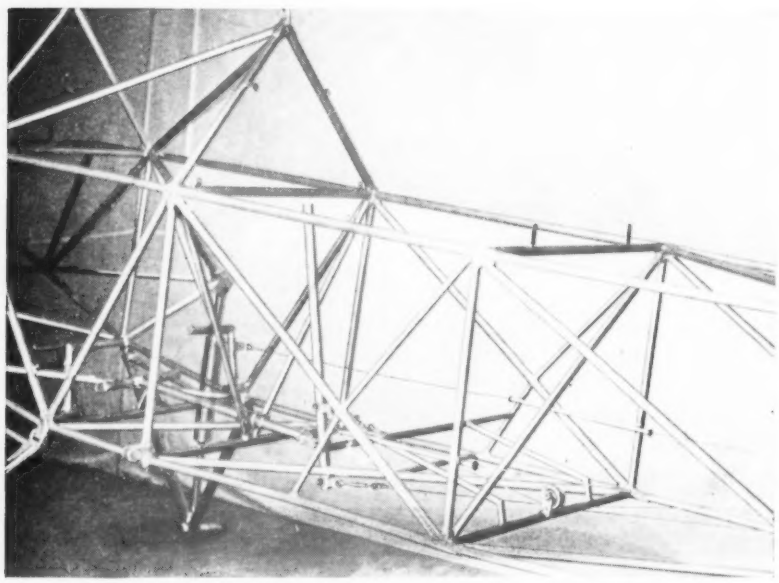
CONTACT! We are off on another instalment of how to build that racy little Ford powered sportplane to the tune of hack saw blades biting their way through that good old steel tubing which will connect the tail-group, motor and wing together.

In other words, this month we will give you the low-down on the fuselage construction and if you don't think the fuselage plays a very important part in a plane, just try and fly without it. No doubt, in the very near future, they will be soaring around, sitting in some kind of a wing. However, it will be quite some time before those plans are published for the home builder, so let's drop the matter and get back to 1935.

When I mention the fuselage, I have visions of an avalanche of letters sliding in on the old desk asking if a wood fuselage can be used instead of the tubing or whether brazing can be used instead of welding all the joints. To save the authors of such letters the price of a postage stamp, I will put it down in black and white that we do not recommend the use of any construction other than that shown on the drawings and you will find a welded steel tube fuselage the cheapest in the end, to say nothing of the extra strength obtained at a saving of weight. So, if you think that wood would be better just go ahead, for it is your money you are spending and it is also your neck.

I want to thank you for the many letters and compliments which have been sent in to me regarding the Super-Ace. When I refer to letters from fellows who always want to change things a little, I do not want you to get the idea that all letters received are like that, for they are not. Since starting to run this series of articles I have received dozens of fine letters from readers who are building this little Ford powered ship, or who plan on doing so soon and I want to personally thank everyone, for it is indeed a pleasure to know that I have designed a sportplane which fulfills a long felt need in the field of amateur aviation.

POPULAR AVIATION has shown its interest in this little job by running a picture of it on last month's cover as well as this series of plans, so the rest is up to you. Now to get on with the actual construction details.



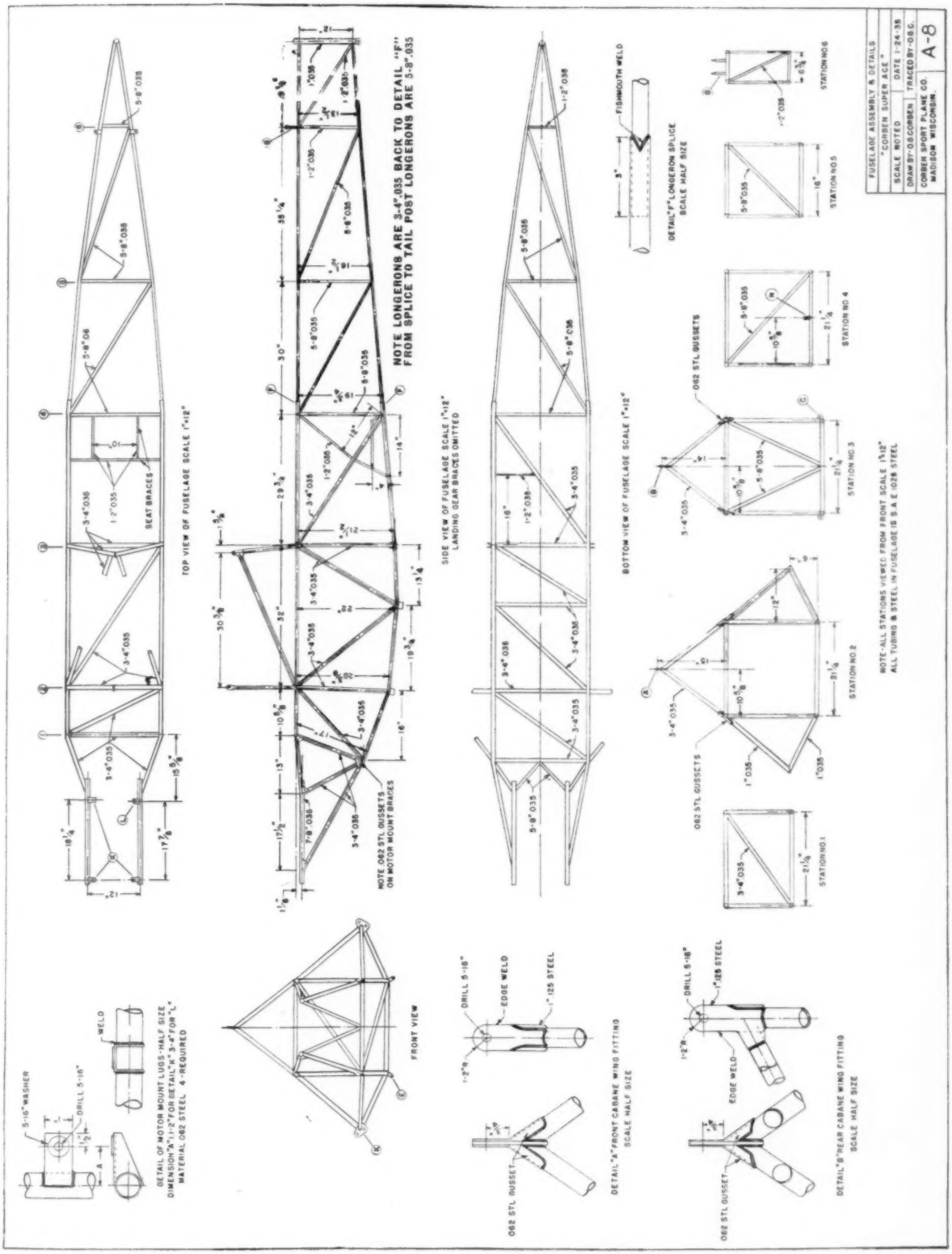
Fuselage of Corben Super-Ace with controls and landing-gear struts.

You will find that building up a welded fuselage is not such an easy job unless you go about it in the right way, but care should be taken in every step of the construction. It is very essential that the fuselage lines up perfect, otherwise the wings and tail-group will not be in alignment, resulting in a poor flying plane or one that is unstable. For those who do not have the facilities for welding, I wish to say that all welded parts, such as fuselage, tail-group, etc., can be purchased factory welded, thus saving a lot of work on the part of the builder.

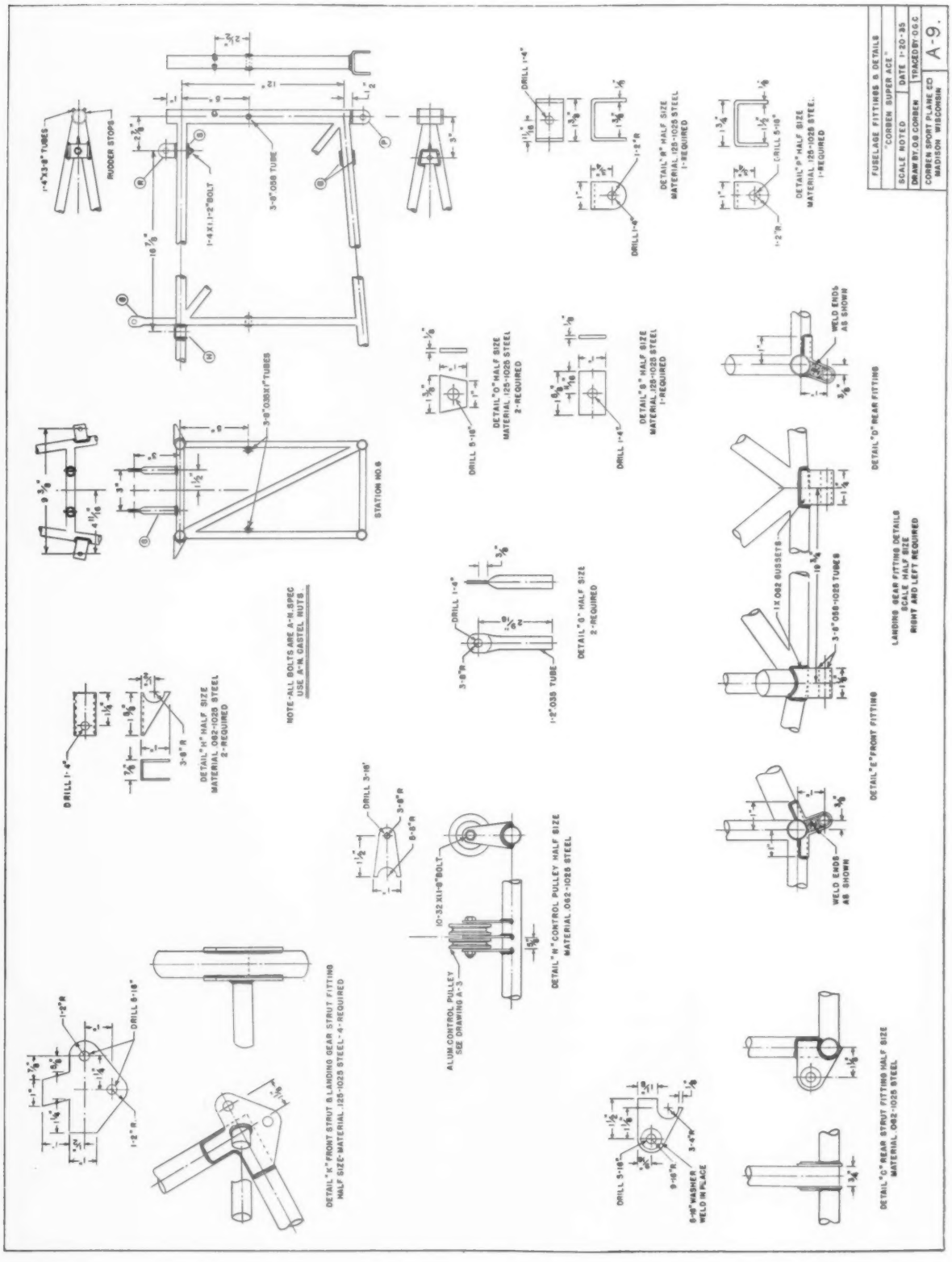
For those who desire to build up the fuselage, let us take up a few outstanding points which must not be overlooked in its construction. You will note that all tubing shown on the drawing calls for S.A.E. 1025. This is carbon steel. Several builders of limited experience have the idea that a smaller size tube can be used if Chrome-

(Continued on page 330)

Fuselage Details for Super-Ace



Fuselage Details for Super-Ace

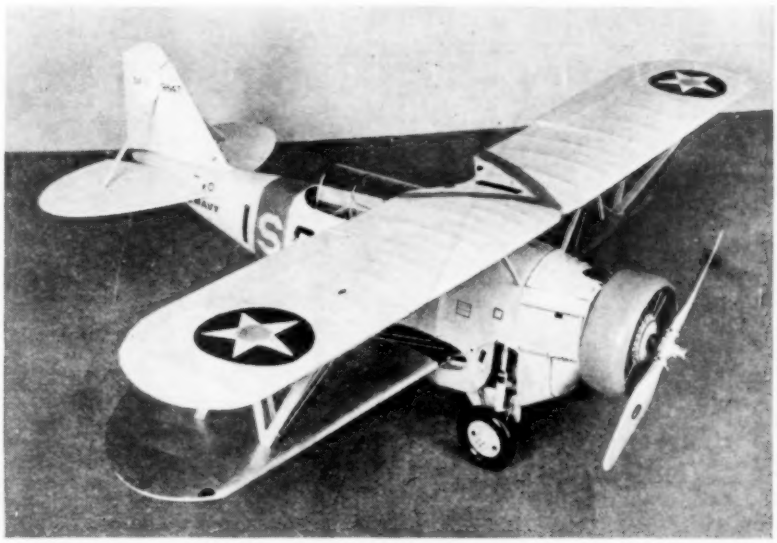

FUSELAGE FITTINGS & DETAILS
"CORBEN SUPER ACE"
SCALE NOTED
DATE 1-20-85
DRAW BY: O.G CORBEN
TRACED BY: O.G.C
CORBEN SPORT PLANE CO
MADISON WISCONSIN
A-9.
RUDDER STOPS
1-4X3-8" TUBES
1-4X1-1-2" BOLT
3-8" .058 TUBE
STATION NO. 8
3-8" .058 X.1" TUBES
NOTE-ALL BOLTS ARE A-N SPEC USE A-N CASTEL NUTS
DETAIL "H" HALF SIZE MATERIAL .062-1025 STEEL 2-REQUIRED
DETAIL "K" FRONT STRUT & LANDING GEAR STRUT FITTING HALF SIZE-MATERIAL .125-1025 STEEL-4-REQUIRED
ALUM CONTROL PULLEY SEE DRAWING A-3
10-32 X11-9" BOLT
DETAIL "N" CONTROL PULLEY HALF SIZE MATERIAL .062-1025 STEEL
DETAIL "G" HALF SIZE 2-REQUIRED
1-2" .058 TUBE
DETAIL "O" HALF SIZE MATERIAL .125-1025 STEEL 2-REQUIRED
DETAIL "I" HALF SIZE MATERIAL .125-1025 STEEL 1-REQUIRED
DETAIL "P" HALF SIZE MATERIAL .125-1025 STEEL 1-REQUIRED
DETAIL "D" REAR FITTING
WELD ENDS AS SHOWN
LANDING GEAR FITTING DETAILS SCALE HALF SIZE RIGHT AND LEFT REQUIRED
1X .062 GUSSETS
3-8" .058-1025 TUBES
DETAIL "E" FRONT FITTING
WELD ENDS AS SHOWN
DETAIL "O" REAR STRUT FITTING HALF SIZE MATERIAL .062-1025 STEEL
9-16" WASHER WELD IN PLACE

Building the Grumman Scout

by

PAUL W. LINDBERG

Model editor and model designer for POPULAR AVIATION.



The completed model of the Grumman Scout is a beautiful job and one of the most interesting we have yet shown.

BY popular request from readers of POPULAR AVIATION, we are proud to present **an exact scale** model of the Grumman Scout SF-1.

This model may appear a little difficult to construct but ,however, this is not true; for time and patience are the essential requirements in the building of this model.

You will see that every small detail has been carried out, even to the shock absorbing landing-gear, which can be retracted. All dimensions can be quickly and accurately determined by placing a ruler on the part to be measured. If you wish a larger model, multiply this measurement by the amount of increase.

COLOR SCHEME

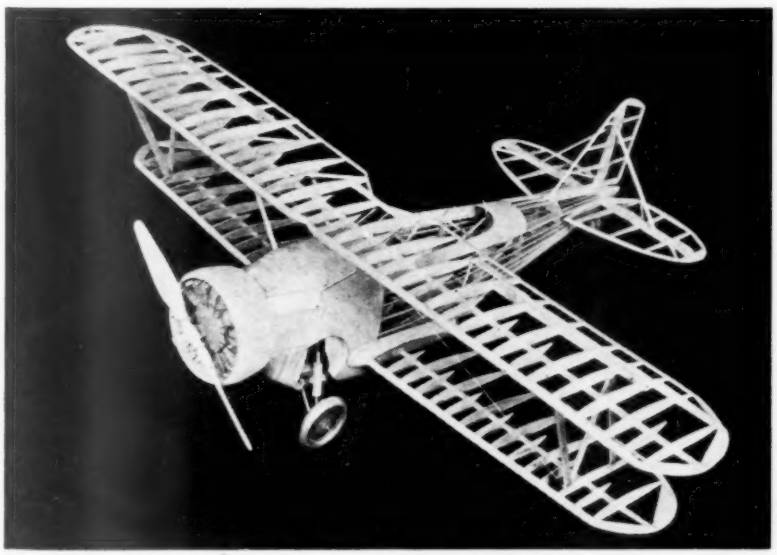
Fuselage, light gray; upper wing, top side, chrome yellow; bottom side, silver; lower wings, all silver; tail surfaces, lemon yellow; trim in black, red and white. Refer to cover.

CONSTRUCTION OF FUSELAGE

First, place waxed paper on top of plan to prevent parts from sticking to plan. The fuselage sides are built from 1/16-inch square balsa. The longerons, verticals, diagonal braces, etc., are held in place until securely cemented by inserting straight pins on either side of strips wherever needed.

When the two sides are completed, the cross-members are cemented into their proper locations. Check carefully front-to-rear for alignment. Cut lower longerons away from former F-9 to F-10. This is to permit installation of landing-gear struts.

The two parallel supports in bottoms between former F-9 and F-10 are 1/8-inch by 3/16-inch. Cut the formers from 1/32-inch sheet balsa and cement in their respective positions as shown on the plan. The position of all stringers are clearly shown on the formers. See plan.



Uncovered frame of the Grumman model.

Work stringers from front to rear and check carefully to see that they have the correct spacing. Four pieces of 1/8-inch thick balsa are cemented together, shaped and fitted to front of fuselage. Cowling from nose to side formers 18 is covered with stiff paper. Use several pieces of stiff paper to make cowl. Former 2 to former 5 can be made from one piece of stiff paper.

CONSTRUCTION OF THE WINGS

Cut all ribs from 1/32-inch balsa. Pin center spar in position on the plan. Now, cement ribs in their proper locations. The leading and trailing edges are cut and sanded to shape and cemented to the ribs. The upper panels carry movable ailerons which are a great help in controlling the flights.

Make wing tips from 1/16-inch thick balsa. We highly approve of this type of wing tip, because it is much easier to construct and neater in appearance.

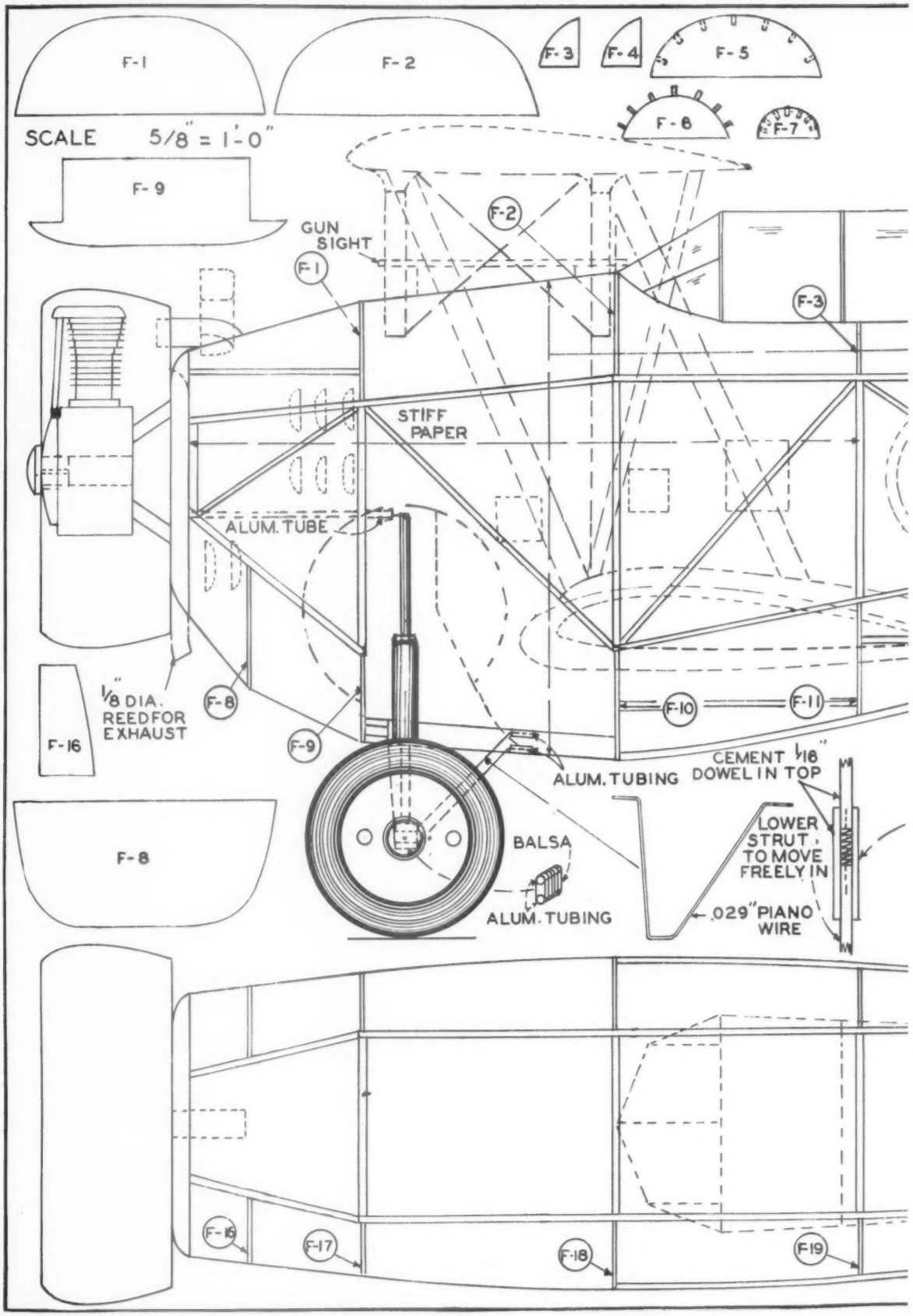
ELEVATOR AND RUDDER

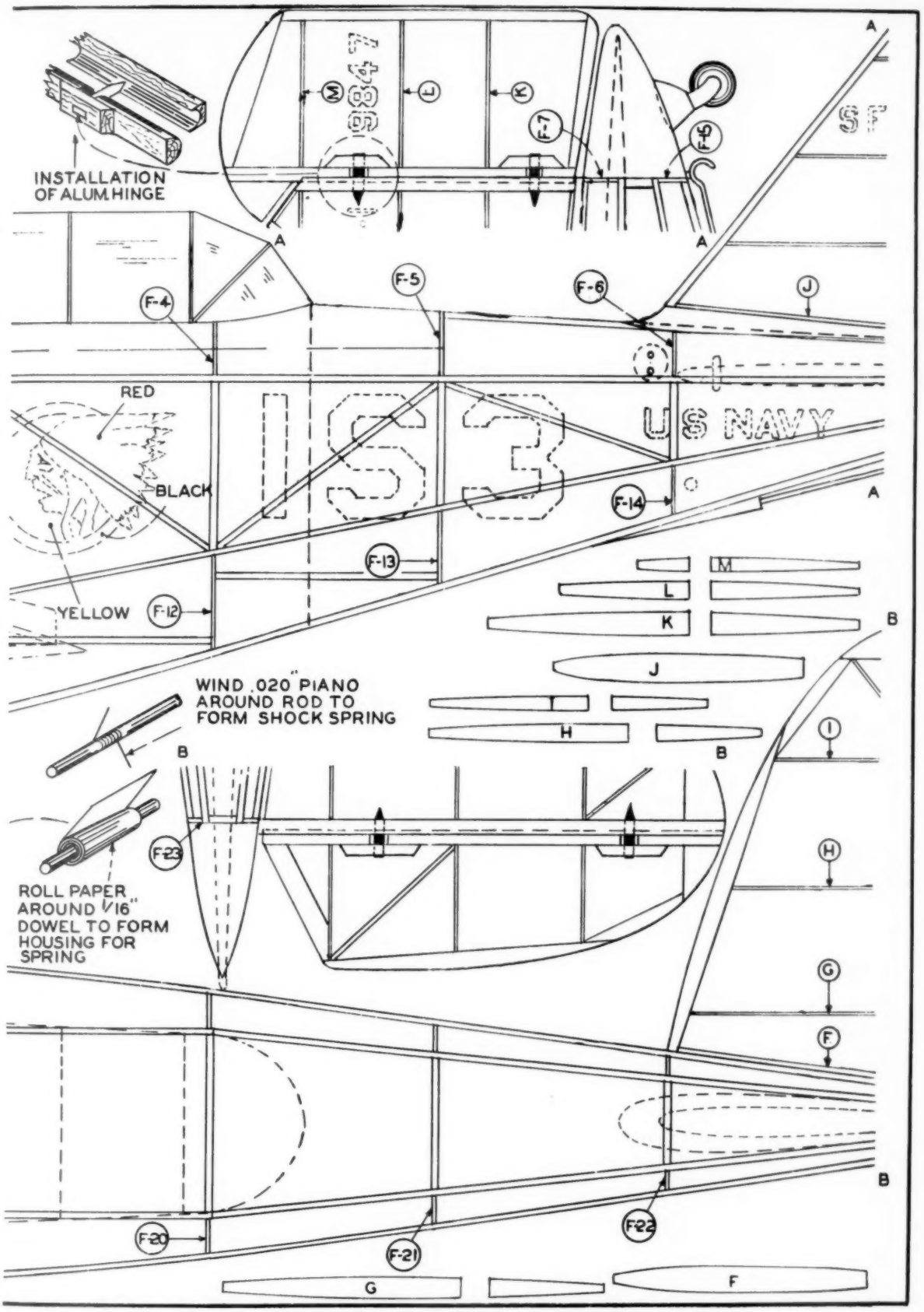
These are both of the streamline form, and require a little care in the construction. Note, all control surfaces are of the interlocking type, and the construction is very similar to that of the large ship. All control surfaces carry aluminum hinges.

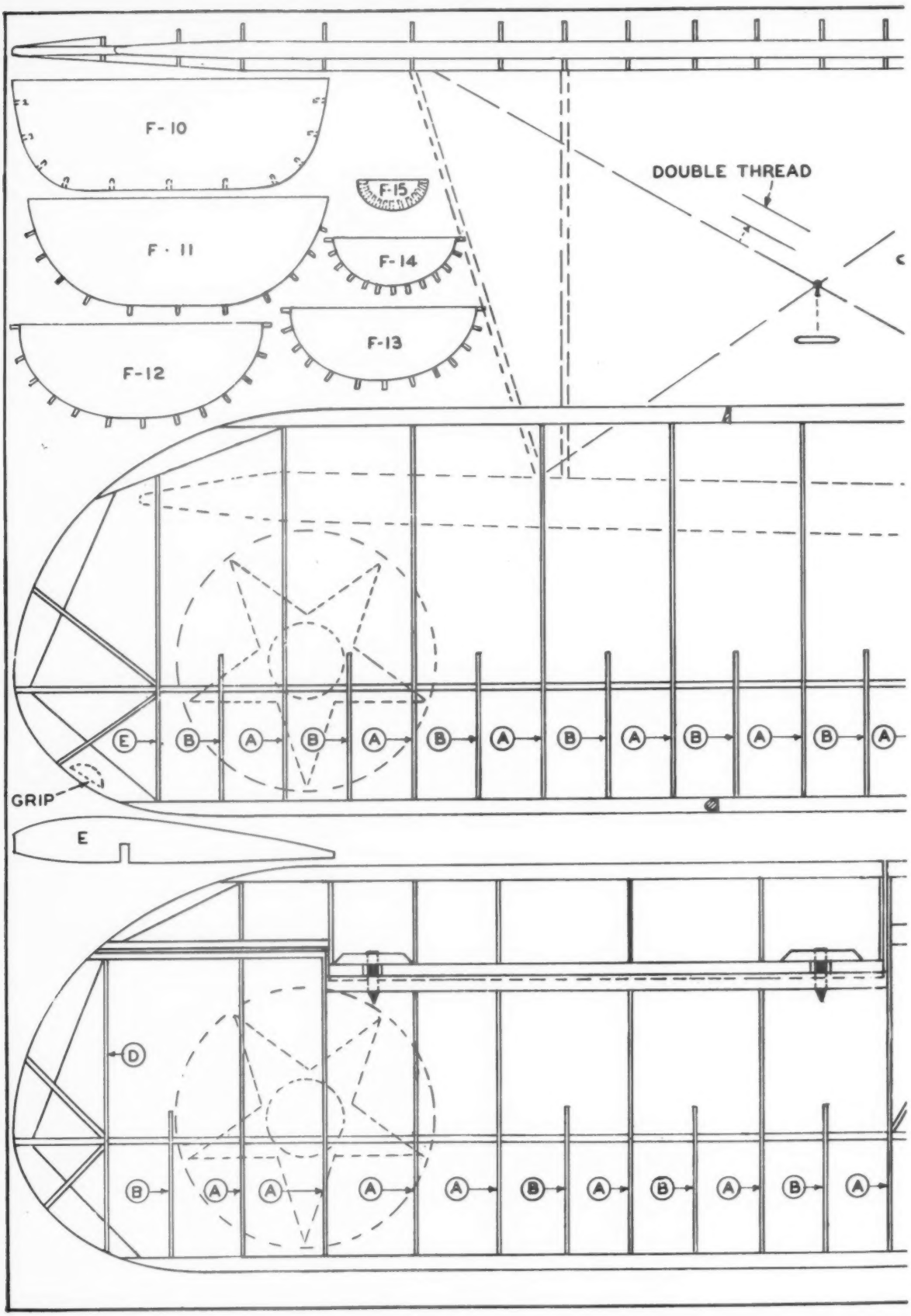
FILLETS

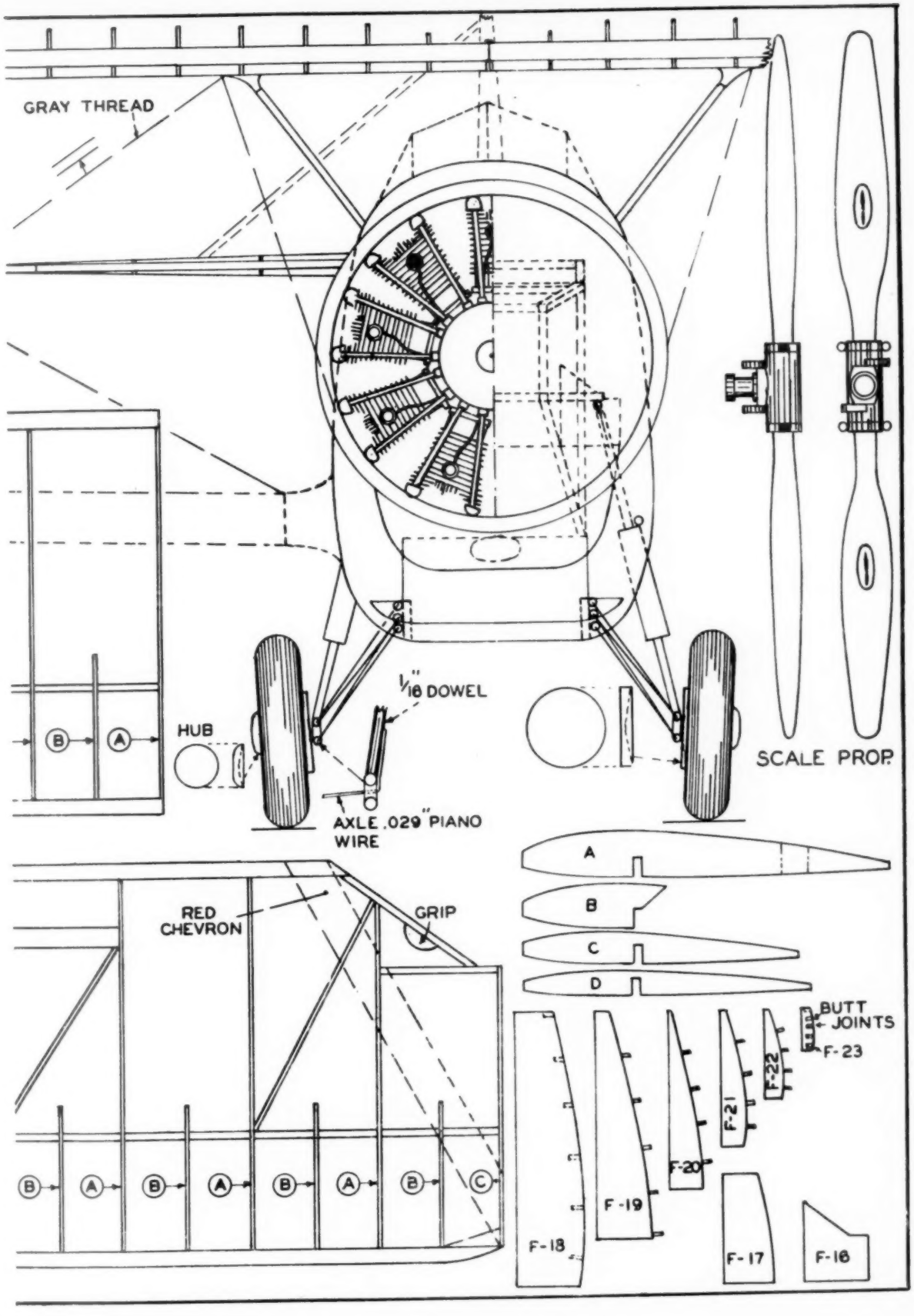
The fillets connecting the lower wing panels to the fuselage are carved from soft balsa and sanded. Great care should be taken when fitting the fillets to the fuselage, so you will have a perfect fit. Any openings along the edges can be sealed with strips of balsa and

(Concluded on page 327)


F-1
F-2
F-3
F-4
F-5
F-6
F-7
SCALE 5/8" = 1'-0"
F-9
GUN SIGHT
F-1
F-2
F-3
STIFF PAPER
ALUM. TUBE
1/8" DIA. REED FOR EXHAUST
F-16
F-8
F-9
F-10
F-11
ALUM. TUBING
CEMENT 1/16" DOWEL IN TOP
LOWER STRUT, TO MOVE FREELY IN
.029" PIANO WIRE
BALSA
ALUM. TUBING
F-8
F-16
F-17
F-18
F-19


INSTALLATION OF ALUM HINGE
F-7
F-8
F-4
F-5
F-6
F-14
F-13
F-12
RED
BLACK
YELLOW
US NAVY
WIND .020" PIANO AROUND ROD TO FORM SHOCK SPRING
ROLL PAPER AROUND 1/16" DOWEL TO FORM HOUSING FOR SPRING
F-23
F-20
F-21
F-22
A
B
J
K
L
M
H
I
G
F


F-10
F-15
F-11
F-14
F-13
F-12
DOUBLE THREAD
E
B
A
B
A
B
A
B
A
B
A
B
A
GRIP
E
D
B
A
A
A
A
B
A
B
A
B
A


GRAY THREAD
1/16" DOWEL
HUB
AXLE .029" PIANO WIRE
SCALE PROP
RED CHEVRON
GRIP
A
B
C
D
BUTT JOINTS
F-23
F-22
F-21
F-20
F-19
F-18
F-17
F-16

The National Glider Movement

by "SPEED" WESTPHAL

Mr. Westphal, an ardent glider enthusiast of long experience, is making great strides in renewing interest in this most wonderful of outdoor sports.

AH, spring is here, with trees whistling in the birds, ponds chirping in the frogs and the sweet odor of new noses in our grass. Yes, sir! Spring is here officially or unofficially, anyway you want to look at it, so we'll get right down to business.

I have just succeeded in gathering a list of states and their laws governing aviation, so for all you fellows that wrote to me for the list; here you are.

Thirty-seven states and territories require federal aircraft license for all operation, including gliders. They are Alabama, Alaska, Arizona, California, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, (Missouri, except for solo pleasure), Maryland, Massachusetts, Montana, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Utah, Vermont, Washington, Wisconsin and Wyoming. Ten states require federal license for all commercial aircraft operation. They are Colorado, District of Columbia, Hawaii, Nebraska, Nevada, North Carolina, Oregon, Philippines, Virginia and West Virginia.

In my last article I gave the primary instructions on how to go about organizing a club. I wonder how many of you really got under way. Those of you who are started, let me hear from you if you run up against the brick wall, will you?

I would like to take this opportunity of thanking all you boys that took the trouble of writing in. It sure makes me feel that I'm being backed up in this movement.

Some fellows wrote in, saying I should spend more time telling the beginners how to get started instead of using the space talking about the clubs that are already active. I'll say right here that the first and main thought in my mind is the beginner. The only reason I use space in regard to the already organized clubs, is that they have written to me, pledging their full support to any individual or newly organized group forming in their locality. I have also received hundreds of letters from beginners asking for information on active clubs that they might join.

The active clubs are just as important in this movement as the beginners, so stick with me and I'll get you all in the air some way or other. Keep your letters coming in and I'll answer each one of them just as soon as I can, however, please don't forget to enclose postage if you want a personal answer.

A glider belonging to the Washington Glider Club.

It has been almost impossible for me to secure a complete list of active glider manufacturers in the United States that at present have a licensable glider or sailplane on the market. The only one I am sure of at the time of this writing is the Bowlus-Dupont Sailplane Company, Inc., located at Wilmington, Delaware. I do not believe they are placing a primary glider on the market, however.

The Mead Glider Company, located at 15 So. Market Street, Chicago, is not active in the glider business, but have on hand a good supply of aircraft spruce, steel, wire and blueprints. They also have on hand a Challenger and contest Challenger, both being secondary enclosed gliders. The license has expired on these two jobs, and as far as I know, they would both have to be re-covered before they would again be eligible for a license.

Several years ago, POPULAR AVIATION published complete plans for the construction of a "Mead" Primary glider. Many fellows made gliders from these plans and flew them with great success; some fellows I know, even enclosed their "jobs" and got darn good performance by doing so.

Now, that the Department of Commerce steps out and tells us we must make changes on these gliders, I think we should step out and have the D.O.C. show us in black and white, just where the changes are to be made. I don't think any of us would mind making the necessary alterations if we knew where they were to be made.

The Department of Commerce has on file complete reports and data on the stress analysis test which the "Mead" glider was placed under, therefore it would be a simple thing for them to study these drawings and draw a few print-sheets, showing the changes necessary. How about you fellows that have gliders constructed?

Sit down right now and address a letter to the Department of Commerce, Bureau of Air Commerce, Washington, D. C. Make a formal request in regards the above matter. Send your letter to me in care of POPULAR AVIATION and I will forward them all to Washington.

At a recent meeting of the Soaring Society of America, held in New York, the following officers were elected for 1935: President, lieutenant commander, Ralph S. Barnaby; vice president, Dr. Wolfgang Klemperer; vice president, Richard C. DuPont; secretary-treasurer, Lewin B. Barringer. Barringer is also secretary-treasurer of the Bowlus-DuPont Sailplane Company. Mr. Bowlus, I understand, is no longer connected with that company.

The Soaring Society of America, as many of you know, are the promoters of the American glider and soaring meet held each year at Elmira, New York. I understand this year's meet will hold forth from June 29 to July 14 and you can bet your long underwear I'll be out there getting results and pictures for POPULAR AVIATION.

The Soaring Society of America is a non-profit organization and is well worthy of your support; annual membership is only $2 and each member receives a monthly magazine published by the society at no extra cost. If any

(Concluded on page 327)

MARTIN BOMBER

Wingspan 35", length 22½", weight 4⅝ oz. Exact scale. Retractable landing gear, rotating gun turret, movable machine guns, special streamline cowlings, two types of 3 bladed propellers—one for flying and one for exhibition with removable motor sticks for flying; rudder and elevator balanced surfaces; new type freese ailerons.
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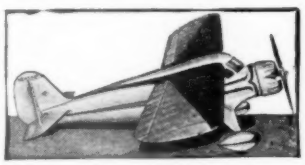
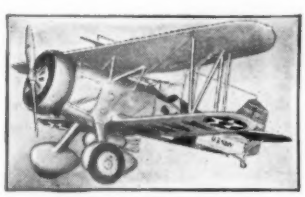


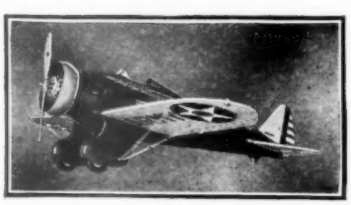
STINSON RELIANT

Wingspan 32 5/16", length 21¼", weight 3½ oz., exact ¾" scale. Here's a plane you'll be mighty proud to own and fly. An exact reproduction of one of the latest 4 passenger cabin planes. You'll find more unusual and different features in this plane than in any other. For example—adjustable speed arresters built into the wings, the movable cabin doors, the complete interior with four seats and control column, and all the other Super-Detail features. Colored in bright contrasting yellow and black.
Kit complete, postpaid..... $2.50



CURTISS GOSHAWK

Wingspan 23⅜", length 16¾", weight 3⅜ oz., exact ¾" scale. You've heard of this beautiful Curtiss Goshawk. Now you can build your own with the most complete kit you ever saw. This snappy little Navy fighter has many more details than you can see in the photo. Everything designed in exact scale of course. Streamlined drag ring specially designed; two detachable blade propellers, and the entire model coated with the new IDEAL high lustre finish, with silver, yellow, red and black coloring. Plenty of material is furnished.
Kit complete, postpaid..... $2.00



BOEING P-26A

Wingspan 21¼", length 18", weight 2½ oz. Exact ¾" scale. One of the newest, most advanced of all fighting planes. Fast, speedy, with full armament; capable of over 240 miles per hour. This flying model is an exact replica of the famous fighter—one that is identical in all but size with its noteworthy big brother. Beautifully colored in olive drab and yellow. All Super-Detail parts included.
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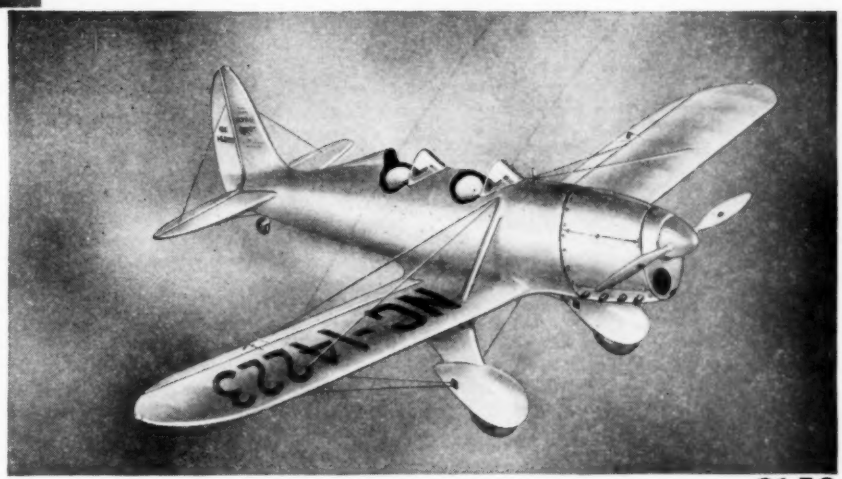
This Beautiful NEW RYAN S T

Another IDEAL Super-Detail Triumph



Ryan S T Wingspan 22½", length 16½", weight 2½ oz., scale ¾". Complete kit **$1.50**

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29"—scale 1/32" to the foot

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☐ Folder with information 3c ☐ Rex $6.00
☐ Ryan S T $1.50

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Engines

(Continued from page 300)

thus are served by a common combustion space. All double-piston designs are of the uni-flow type, which will be shown later as essential for the successful performance of any engine operating on the two-cycle principle.

A number of schemes have been employed for externally creating an inlet pressure to scavenge engines of this type. The original two-cycle engine invented by Sir Dugald Clerk was fitted with a single-acting piston pump driven from the crankpin of the working cylinder.

Later, inventors used piston pumps driven from the crankshaft; some of these being single-acting of the concentric arrangement, while others were of the double-acting variety. But such methods have proved to be quite inefficient, and the weights of the engines were comparatively high for the horsepower delivered.

An advanced step in this same direction is represented by the engines fed by blowers. These blowers are driven in the most convenient manner from the engine crankshaft, and may be of the centrifugal, sliding-vane or Roots type. Such units insure a positive pressure at the air inlet, and operate at fairly high mechanical efficiencies.

Without going further into the variety of classifications, let us consider some of the problems that are common to all two-cycle engines. We then may intelligently choose the form of construction best suited for the purpose we particularly have in mind.

One only has to consider the time involved in a complete cycle of operations to appreciate the major difficulties confronting the builder of a two-cycle engine. The cylinder receives, compresses, fires, and exhausts a charge during two strokes of the piston. These operations require four strokes of the piston for accomplishment in the four-cycle engine. This means that each phase of a cycle cannot employ more than one-half as much of the rotational period of the crankshaft, and a pressure that is available only by the use of a blower is essential for complete scavenging and good volumetric efficiency.

Designers of two-cycle engines in the past have paid too little attention to the flow of gases during this short period of scavenging and filling. As a result, there have been frequent cases of too much fresh gas escaping through the exhaust, and so much residual unscavenged that the fresh mixture became very weak.

It is agreed generally that the only way to approach ideal conditions in an engine of this classification is to employ the uni-flow principle; that is, introduce the fresh mixture at one end of the cylinder and exhaust the burnt gases from the other. In this way, more residual gas is ejected, and there is less opportunity for the incoming charge to mix with it during the period when both inlet and exhaust valves are open.

Right at this poirt it would be well to pause and consider how these rerequirements affect the problem before us. Blowers of all types are at present quite costly to manufacture and, since an engine should be blower fed, it becomes exceedingly doubtful if the combined blower and engine will cost less than a conventional four-cycle engine of corresponding output.

This statement is not intended to be preclusive in its meaning, but to draw attention to the fact that a successful two-cycle engine, for the purpose at hand, is not the simple solution that some of its adherents would have us believe. However, we must agree that the two-cycle engine is replete in possibilities, and it probably will be interesting to observe the developments in this field which inevitably will appear in due course of time.

Before leaving two-cycle engines, it might be well to include a few remarks relative to the increased use of this cycle in the Diesel types recently. The Diesel, or compression-ignition engine, receives its injected fuel supply under high pressure at a time when both valves are closed and the fresh air has been compressed. Combustion is substantially complete before the exhaust valve opens, and the scavenging is done by fresh air, which permits an overcharge for complete scavenging without the attendant waste of fuel common to engines supplied with a fuel and air mixture.

Most all engines using heavy fuels are more efficient in the larger sizes, and there is no need at this time to consider them for aircraft engines of small output. However, we have learned something from the large two-cycle Diesel designs that may apply equally well to the present problem.

Since it is obvious that the serious inherent faults of the two-cycle engine are not present to a marked degree in the Diesel types, why not arrange these small two-cycle engines, which we recognize must be blower fed, to have their more volatile fuels injected into the cylinders instead of being mixed with air previously in a carburetor? Some rather encouraging developments in injection systems for four-cycle automobile engines are now under way, and these could be applied readily to this problem as outlined.

It seems unnecessary to add to the preceding discussion as regards the prospects of developing new engine designs to meet the existing lightplane requirements. Like most branches of engineering, the field of opportunity appears exceedingly fertile. But, new developments are costly as a rule, and there seldom is any definite assurance that success will crown such efforts. Moreover, there is a time element to consider and—as pointed out in the beginning—this market is now waiting for a dependable, light-weight engine which can be sold at a comparatively low price.

Existing experience in the manufacture of internal combustion engines for various purposes provides ample background for estimating what reductions in cost may be expected with volume production. Naturally the writer feels that the safer and shorter course lies in creating volume output for a simple and sturdy design of the desired power—so now comes the question.

(Continued in June issue)

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June in P.A.

READERS who have enjoyed POPULAR AVIATION in the past as well as our new friends, will find the June issue of P.A. to be of surpassing interest.

In keeping with the spirit of June, which finds the flying season at its height, there will be much attention paid to practical flying problems and field problems. All active pilots will be particularly interested in this group of articles.

And then, there will be the usual departments which have proved so popular in the past with the casual reader as well as men and women of the industry. The June issue will be an outstanding issue that you cannot afford to miss.

The New LAIRD on Cover

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Regular Pilot Albert Ball (United Air Lines) gives his views of training schools

"Since I graduated from Boeing—"

"I've seen too many men with a pretty diploma trying to land jobs that required a background they just didn't have," wrote Albert Ball to a younger friend recently. "My advice to you is choose a conservative school like Boeing—where, besides flying, they give you plenty of hours of 'practical' and 'theoretical'."

We reproduce this comment because it expresses so aptly the viewpoints of United Air Lines and of Boeing School itself. Any Boeing graduate will agree that the courses here are much more comprehensive than those usually offered.

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Division of United Air Lines

"How to decide on your Aviation School"

W. D. Williams, Pilot Midwest Division, United Air Lines, lists 7 vital points to investigate:

- Has it a "playboy flying school" reputation — or is it known for its hard work?
- What equipment will I *actually* work with — in planes, laboratories, shops?
- Who are the men I will *actually* study under?
- Has school advantage of direct association with a large airline?
- What are its graduates doing?
- How does the U. S. Govt. rate it?
- Are students lured by promises of jobs; or are they attracted by the school's superior training?

NEXT REGULAR ENROLLMENT JULY 1

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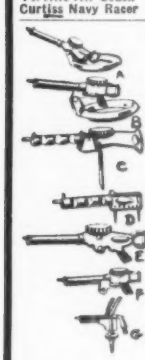

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1¼" long B 25c
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¾" long.....5c
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1" dia..9 cyl. 30c
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1½" dia.....30c pr.
1¾" dia.....33c pr.
2" dia.....35c pr.

Celluloid Wheels		Balsa Wheels	
¾" dia.	8c pr.	1"	6 pr.
1" dia.	10c pr.	1¼"	8 pr.
1⅜" dia.	15c pr.	1⅞"	10 pr.
1⅞" dia.	20c pr.	2⅜"	15 pr.
2" dia.	40c pr.	3"	40 pr.

Swivel Joint Fork and Axle
⅛ up to ⅝" wheel 10c
¾ up to ⅞" wheel 15c

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½" dia..... 5c ea.
⅝" dia..... 6c ea.
¾" dia..... 7c ea.
⅞" dia..... 8c ea.
1" dia..... 9c ea.
1⅛" dia.....10c ea.
1¼" dia.....11c ea.

AXLES—Threaded—fitted with washers, bushings and nuts.

Length	⅛ to ⅜	½ to ⅝	¾ to ⅞
2"-3"-4"	12c	10c	20c
7"-8"-9"	14c	12c	23c
10"-11"-12"	18c	15c	25c

Postage 3c Pair—on Rubber Tired Wheels, 4c Pair

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Hawk Type 2-bladed		3-bladed		Die Cast 2-bladed		3-bladed		Standard 2-bladed		3-bladed	
3¼"	25c	4"	35c	1½"	10c	2"	15c	1½"	15c	2½"	20c
4"	30c	4½"	45c	2½"	15c	3"	20c	2½"	20c	3"	30c
4½"	35c	5"	50c	3⅛"	20c	4"	30c	4"	30c	4"	40c
5"	35c	5⅝"	60c	4"	25c	4½"	40c	4½"	40c	5"	45c
5⅝"	40c	6¼"	70c	4½"	25c	5"	45c	5"	45c	6"	60c
6¼"	40c	7"	80c	5"	50c	6"	60c	6"	60c	7"	70c
7"	55c	8"	90c	5½"	35c	7"	70c	7"	70c	8"	80c
8"	65c	9"	$1.00	6"	40c	8"	80c	8"	80c	9"	90c
9"	75c	10"	1.10	6½"	45c	9"	90c	9"	90c	10"	$1.00
10"	85c	11"	1.25	7½"	50c	10"	$1.00	10"	$1.00		

Props can be had up to 24 in. dia. Postage 6c each.

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D E. 3/16 center hole, ¾" long. 3/32 outside hole, E doz.....20c

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1½"	20	20	20
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3"	30	30	30

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3/8"	4c	2" dia.	30c	1⅝"..12c		
5/8"	5c	3" dia.	35c	⅞"... 8c	3" dia.	35c

IMPORTANT—Minimum order, 50c. Add postage on all items but if over 15c on less than $1.50 order add only 15c. Orders over $1.50 add 10%; west of Denver 15%.

SELLEY MFG. CO., INC. Dept. 405
1373 GATES AVENUE, BROOKLYN, N. Y.

High-Lights

(Continued from page 306)

ALICE B. WALKER, secretary of the Chicago Girls' Flying Club, has written a letter to Mayor Kelly urging that Sixty-third street be renamed Amelia Earhart road in honor of the former Hyde Park high school girl, who has become America's most noted woman flyer.

* * *

ART CHESTER, Leland Miles, Mrs. Maxine Howard, Howard Hughes, Col. Roscoe Turner and leading speed pilots are tuning up for the coming 1935 National Air Races. Col. Jimmie Mattern is certainly developing into a radio ace. Norman Alley, of Flying Family Hutchinson fame, is in town and is a newsreel editor.

* * *

THEY tell me that Ed Sullivan, New York columnist, and all of the folks lucky enough to be vacationing in Florida, set their timepieces according to the arrivals and departures of pilot Dick Merrill and his big Douglas. It's a good thing they don't depend on Ray Parer for time, as Ray just managed to finish about four months after the start of the great air race from London to Melbourne.

* * *

KUHN, LOEB & CO. has purchased 30,000 shares of Transcontinental and Western Air, Inc., from Pittsburgh Aviation Industries, becoming the second largest stockholder of TWA. General Motors, with 81,000 shares, holds the largest single interest.

* * *

ALL 1934 officers of the Aeronautical Chamber of Commerce of America have been re-elected with the following new governors: Claire Egtvedt, president of the Boeing Airplane Company; B. D. DeWeese, president of the Stinson Aircraft Company; J. H. Kindelberger, president of North American Aviation, Inc.; C. R. Smith, president of American Airlines; E. V. Rickenbacker, general manager of Eastern Air Lines; Croil Hunter, president of Northwest Airlines; C. Bedell Munro, president of Pennsylvania Airlines; Jack Frye, president of TWA, Inc.; W. A. Patterson, president of United Air Lines; Oliver L. Parks, president of Parks Air College; Alford J. Williams, manager, aviation division, Gulf Refining Company; Frank Tichenor and Fred L. Smith, president of the National Association of State Aviation Officials.

* * *

CANADIAN statistics show that one large air operator carried for the first six months of this year 2,539,000 pounds as against 1,573,000 pounds carried by United States, domestic and foreign routes. Judge Alfred Dulweber of Fort Morgan, Col., could help American airlines by taking a few more air voyages, as the Judge tips the scales at an even 410 pounds. Miss Alice Rasor, 95-pound stewardess for the United Air Lines, reports that the Judge had no difficulty in occupying a regular seat.

* * *

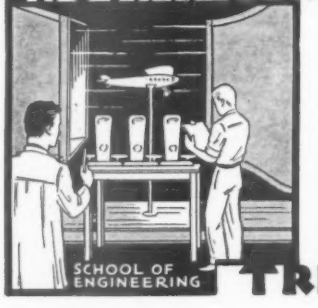
AWARDS: Senator William J. McAdoo, president of the National Aeronautic Association, presented certificates of merit for record-breaking feats in the air to Mrs. Jeanette Piccard who, with her husband, Dr. Jean Piccard, ascended 57,559 feet into the stratosphere from Detroit some months ago. Others honored by the association were Major William E. Kepner, Captains A. W. Stephens and O. A. Anderson, Raymond B. Quick, John H. Wright, Roger Don Rae (champion parachute jumper for 1934), Helen MacCloskey, S. J. Wittman, Arthur C. Chester, Knefler McGinnis, Boris Sergievsky, James H. Doolittle, Clyde Pangborn, Roscoe Turner and Eddie Rickenbacker for the Inter-city speed record for transport planes between Burbank, Calif., and Newark, which causes us to ask the Senator if he ran out of certificates when it came time to honor the pilots who actually flew the transport plane for the record.

* * *

ANNOUNCEMENT has been made by the War Department of the formation of a general staff for the general headquarters air force. The air force will be under the command of Col. F. M. Andrews and the general staff will consist of Major Hugh J. Knerr as Chief of Staff with Lieut.-Col. Henry H. Arnold in command of the Pacific Coast wing, Lieut.-Col. Henry C. Pratt the Atlantic Coast, and Lieut.-Col. Joe C. Brant the central states wing.

END

AERONAUTICAL ENGINEERING
DEGREE IN 2 YEARS

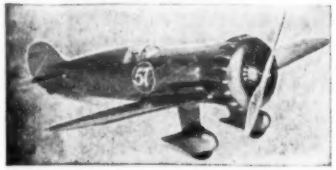


Become an Aeronautical Engineer. Tri-State College course given in 108 weeks. Bachelor of Science degree. Graduates in Mechanical Engineering can complete aeronautical course in 2 terms (24 weeks). Thorough training in all fundamental engineering subjects. Equipped with wind-tunnel (see illustration). Non-essentials eliminated. Courses designed to save student time and money. Flying school facilities available at nearby airports. Properly trained engineers in design, research, manufacture and sales work are in demand. Enter March, June, September, January. Courses are offered also in Civil, Electrical, Mechanical, Chemical, Radio and Architectural Engineering; Business Administration and Accounting. Living costs and tuition low. Those who lack high school may make up work. World famous for technical 2-year courses. Graduates successful. Write for catalog.

755 COLLEGE AVE. ANGOLA, IND.

TRI-STATE COLLEGE

Biggest News that Ever Hit the Model World!



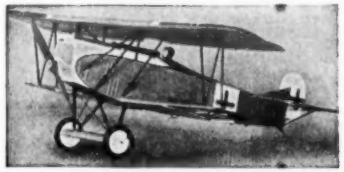
TURNER'S WEDELL-WILLIAMS

Another ship needing no introduction since our beloved Col. Roscoe controls it wherever she goes. The '34 Thompson Trophy winner. Fast flying model. Suggested coloring: Wedell-Williams gold. Has a span of 13", length 11". A real beauty. Kit D-48, postfree..... **50c**

Think of it--genuine authentic C-D scale flying models for only 25c to 85c!

Every single one authentic ½" scale—every single one a *flying* model—every single one a model selected for its widespread popularity! No wonder C-D "Dwarfs" are an overnight sensation—sweeping the country—no wonder they're the talk of modelbuilders everywhere—no wonder both builders and dealers have been stampeding us with rush demands. A front page achievement—just the kind of years-ahead leadership modelbuilders have been given to expect from Cleveland and with 14 new kits—all at once!

Some of the features of these "Dwarf" Kits are, all wood entirely printed out, including rings for radial engines on designs requiring them (on wartime jobs and those with NACA cowls, a beautiful smooth turning for the cowl front is supplied, as are all finished wheels in every Kit except D-19), nose blocks drilled, and all machine work completed, only handwork left to be done. This also includes a beautifully sawn balsa prop center drilled. All insignia, where necessary, supplied. Absolutely everything included EXCEPT LIQUIDS (and striping tape for liquids) to build up a beautiful exhibition model, capable of good flights, and, by the elimination of many details, ribs, stringers, etc., considerably lightened for greater duration flying qualities.



FAMOUS WARTIME FOKKER D-7

Wings taper beautifully, new feature control movements (as on many C-D's), scale propeller, authentic Spandau guns (you make all). Suggested coloring: international orange, green, white, black details. Span 14⅛", length 11¼". Kit No. D-15B..... **60c**

Remember! All Dwarfs Absolutely Complete but WITHOUT LIQUIDS.
Also 10c packing charge on each kit if less than 6 ordered.

NAVY CURTISS F11C-2

The plane which needs no introduction as it has already made an excellent name for itself in Navy work. Beautiful flying model. Suggested coloring: the characteristic silver with gray fuselage, green tail surfaces, cowl and other trimmings, and yellow upper wing. Span 15¾", length 10⅝". Kit D-49..... **85c**

LINCOLN SPORT

A lightplane sensation. Beginner's model. Span 10", length 8 1/16". Suggested coloring: cream, black trim. Kit D-36..... **25c**

GB SUPERSPORTSTER

Doolittle's 1932 Thompson winner—and a beauty. Fast flights. Span 12⅛", length 9". Suggested coloring: white, red, sealoping. Kit D-27..... **50c**

Build the Complete Thompson Trophy Line-up

All six models from 1929 to 1934 (D-2-46-17-27-47-48) only 50c each. Think of it. If you purchase them individually, they cost 10c extra for packing and handling, but if six or more are purchased, no extra charge need be included. Simply send your $3.00 for the six models.

SUPERMARINE S6-B

Will R.O.W. Span 15", length overall 14½". Suggested coloring: silver and blue. Kit D-19..... **65c**

HOWARD RACER "IKE"

Flies and climbs beautifully. Span 10⅛", length 8⅛". Suggested coloring: white with black details. Kit D-42..... **25c**

CURTISS P6-E ARMY HAWK

Even exhibition models could not outclass this new beauty for external appearance—and she flies very well, too! Suggested coloring: yellow and olive-drab with beautiful color marking of Selfridge Field Squadron; with black lettering and red striped top wing. Span 15¾", length 11 1/16" Kit D-21B..... **75c**

MONOCOUPE

Span 16", length 10¼". Suggested coloring: Beautiful cream and orange. This design has won many first prizes for modelbuilders. Kit D-28B..... **45c**

AERONCA C-3

Easy for beginners. Span 18", length 10¼". Suggested coloring: red and silver. Kit D-40..... **60c**

MORE DWARFS!

In addition to those shown here, we also have Dwarf Kits for—

'29 Tr. Air M. S.	50c
'30 L. Solution	50c
'31 Bayle's G-B	50c
'33 Wedell-Wms.	50c
Hawker S. Fury	45c
Lockheed Vega	85c
Waco C-3	75c
Vought Corsair	85c
Comper Swift	30c

HEATH PARASOL

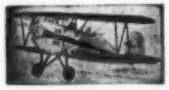
Span 15½", length 8½". Suggested coloring: mostly orange, decorative black fuselage side panel. Excellent for beginners, and a duration flyer order. Kit D-26B..... **35c**

BOEING P-26

Very popular. Span 14⅛", length 12". Suggested coloring: yellow and olive drab. Kit D-23..... **65c**

DOUGLAS O-38 OBSERVATION

Very beautiful and unusually well detailed model. Authentic only as "Cleveland" makes 'em! Span 20", length 15¼". Suggested coloring: yellow, olive drab, black details. 2 pilot blocks. Kit D-45..... **85c**



G. L. SPORT TRAINER

Excellent flights. Span 13⅝", length 10⅛". Suggested coloring: orange and cream. Kit D-1G..... **65c**

BOEING PI2-E

Span 15", length 10¼". Suggested coloring: yellow and olive drab, red and yellow trimmings. Kit D-8C **65c**

FOKKER TRIPLANE

Plane of Germany's greatest ace, Von Richthofen. Span 11⅜", length 9⅜". Suggested coloring: all red. Kit D-14C..... **45c**

MODELBUILDERS!

Try your dealer first. If he can't supply you, order direct. Also send 5c for complete No. 16 Catalog of our ½" scale line of 50 models and C-D supplies and catalog of 29 C-D "Dwarfs." If only "Dwarf" catalog is desired, send 3c stamp.

DEALERS! CLUBS! SCHOOLS! write immediately for discounts on these rapid-fire sellers.

IF ORDERING DIRECT, add 10c per Kit for packing and handling charge. We always pay postage ANYWHERE. If half dozen or more are ordered at one time, there is no packing or handling charge. No C.O.D.'s—send check or money order—cash at your own risk. Shipments ALWAYS rushed. To Canada, Mexico and British Isles, add 10% to all prices; other countries, add 20%.

A-W QUAD FIGHTER

Very unusual. Steady flyer. Now authentic rib spacing. Easy to build. Span 14", length 12¼". Suggested coloring: red, white and blue. Kit D-11..... **45c**

BOEING 95 MAIL

Easy for beginners. Redesigned for beauty and even greater duration than ever before. Span 22 3/16", length 16". Suggested coloring: blue and silver. Kit D-32B **85c**

HOWARD "PETE"

An easy-to-build Air Race model—fine flights. Span 10", length 8⅜". Suggested coloring: all white, black details. Kit D-18B **30c**

CLEVELAND MODEL & SUPPLY CO., INC.

"Quality — Value — Lightning Service"

1866PAE West 57 St., Cleveland, Ohio, U. S. A.

Airy Chat

(Continued from page 278)

camp, the deluge of mail has been overwhelming since the notice appeared. And we have been told repeatedly by the builders of gliders, models and sportplanes that they have had the same response after a description of their ship or model appeared.

* * *

WE WERE interested in knowing how many gasoline engine propelled models had been constructed in the United States and inserted a notice to this effect in the "Airy Chat" a few issues back. As a result, we have a great number of photos and descriptions of these models that we will publish in our next issue. Some of these baby airplanes have made extremely long flights, both as to time and distance, and I am sure that even our older readers wil be interested in this phase of model building. It's the next thing to flying a real full size plane.

* * *

MUCH PRAISE must be given to those unselfish and enthusiastic men who have volunteered to give their services as aviation instructors in the various public high schools and shelters. For their services, so freely given, few of them receive any compensation whatever and at the best, this hard work nets them only a few dollars per week. These men broadcast aviation interest into fertile fields and are teaching the airplane owners and pilots of tomorrow the why and wherefor of aviation.

* * *

GASOLINE, while receiving very little attention at the hands of the public, or even pilots for that matter, is the backbone of aviation. If it were not for present day aviation gasoline, there would be little progress possible in the manufacture of the modern aviation engine. This lack of interest, probably, is due to the fact that the aviation public knows less and cares less about the chemistry of products than they do of mechanics.

In order to spread a little light on the subject of aviation gasoline, we have had Mr. Keith Fanshier prepare the article which appears in this issue. This story is well worth reading and will give you contact with the more important phases of motor fuels and the future of gasoline in particular.

* * *

WE had a lot of inquiries concerning our new "Planes Wanted" column and a number of advertisements have been sent in, but unfortunately they arrived too late for this issue. And so, fellows, just send in the ads for the ship that you desire and we feel certain that you will be well satisfied with the results. And remember—it's free.

* * *

THE automobile gave a great boost to the science of metallurgy. If it were not for the automobile it is doubtful whether we would have the many high grade alloy steels now available for the auto and other purposes, steels like molybdenum, chromium, vanadium and others.

The airplane, in the same way, is developing another series of alloys, alloys that must be both strong and light. Wonderful strides have been made in the development of the aluminum series of alloys since aircraft became a reality—and there are more to come.

* * *

GETTING back to airliners, we think it strange that so few airlines fly on exact scheduled time. In very many instances, the airliners are late in arriving at their destination and are frequently late in taking-off. The fact that high rates are charged for fast service on the airlines is rather disappointing to the traveler when he arrives an hour late.

* * *

WELL, here's a good stopping point and I think that I will take advantage of it. So long, fellows.

J. B. R.

Again Waco writes Air History

THIS TIME WITH A NEW 4-PLACE CUSTOM CABIN WACO

Here truly is the last word in luxurious, practical, and economical air transportation. This new WACO further emphasizes WACO leadership in design, construction, performance and outstanding value.

Distinctive new lines permit an appreciable increase in speed using only 80% of the available horsepower. This means lower gas consumption, lower operating cost, and longer engine life.

The Custom Cabin WACO is offered with the following power plants and cruising speeds—Continental, 133 miles; Jacobs, 137 miles; Wright, 145 miles; all based on 1900 R.P.M. Detailed performance figures will be supplied through any WACO dealer or sent to you direct upon request.

OTHER FEATURES OF THE CUSTOM CABIN WACO

Rounded windshield—adds speed—improves visibility ● Indirectly lighted non-glare instrument board — ample room for night or blind flying instruments ● Direct cranking electric starter ● Safety glass in windshield and four side windows—top and rear windows non-cracking Plastacele ● Steering column and front seats adjustable fore and aft ● Stabilizer control mounted on steering column ● Flaps independently controlled—not connected with stabilizer adjustment ● Balance tab on aileron, adjustable in flight, permits correction for wing heaviness when wing tanks are emptied separately.

THE WACO AIRCRAFT COMPANY, TROY, OHIO

WACO AIRPLANES

"Ask Any Pilot"

WACO LEADS IN AIRCRAFT REGISTRATION

Grumman Model

(Continued from page 315)

cement, then sanded down for a smooth finish. The rudder fillet is made in the same manner.

MOTOR

The motor cylinders are built up from sheets of stiff paper and balsa cut into discs to represent the fins, etc. When the motor is complete, it is attached to front of fuselage by 1/8-inch square motor-mount braces.

LANDING-GEAR

We have gone into a great amount of detail in drawing the different views on the plan, and we believe you should have no difficulty here. Study details carefully.

COVERING THE MODEL

Apply tissue to the various framework members, using a light grade of model airplane dope to fasten it to the outer edges. Stretch tissue as tightly as possible to remove all wrinkles. When edges have dried, apply coat of water to tissue. When all water has dried completely, tissue will become taut. May we suggest that you pin wings, elevator, and such upon a flat surface to keep from warping.

Next, apply a coat of clear dope to all surfaces. Now apply colored dopes.

END

Gliders

(Continued from page 320)

of you fellows are interested in becoming a member, drop me a line and I will forward it to the society.

I have just completed a movie-air story in which gliders play an important part; now if I can convince one of the producers down on the west coast what a wonderful and different picture it would be, I'm sure it will be one of the greatest methods of making the general public glider-minded. If my original plans are carried out, the cast will include the big names in the glider-world.

And it's up to you whether you wish to be enrolled with these men.

Before I trip my release hook for this month, I want to give special thanks to the following: Don Stevens (Richard DuPont's chief mechanic); Mr. and Mrs. Earl Johnson of Wichita, Kansas; "Mikey" Jensen; "Blondie" Weddle; J. M. Patterson, Dayton, Ohio; W. A. Rose; and members of the folfowing clubs: The Washington Lee Glider Club, Main Line Flying Club and the Aero Club. Let's see you fellows ground me with mail. So long till next month.

END

Test Pilot

(Continued from page 284)

other Wright Field officer accompanied the body of Lt. Woodring, dead from a crash, to Washington, on the same train, leaving at the same hour of the same day!

Lt. Woodring, flying a ship similar to the one in which Elmendorf was killed, dropped to his death on the earth, four thousand feet below, when his ship disintegrated when he pulled it out of a three-hundred-mile-per-hour power dive. Lt. Woodring, apparently knocked unconscious by the force of the disintegration, never pulled his rip-cord. His body, thrown clear of the airplane, hurtled straight down. The airplane was scattered over a five-mile area.

Test pilot! His job is full of adventure, real danger and thrills. No other man is so completely at the mercy of other men's mistakes.

It's all in the day's work, though, to these men. A death means attending the funeral of a fellow pilot and a brother officer. Perhaps a heavy heart for a few hours, and then back into the air, testing another new ship. Who knows what will happen? It's better not to dwell on the fact—just go ahead and fly.

END

BARGAIN AVIATION SUPPLIES

HELMET AND GOGGLES BOTH ONLY $1

Here's the helmet you have always wanted. The P. A. helmet is worn by Aviators, Sportsmen, Autoists, Motorcyclists, and Motorboat operators. A wonderful chance to get a pair of aviator type cushioned goggles *thrown in free.* Order now BOTH—only $1.00.

FACE MASK used by aviators, motorists, and sportsmen to protect face from cold winds, mud, rain, hail, etc. Made of black leather, lined with wool. Specially processed mouth opening. Only $1.98.

GOGGLES packed in aluminum cases. Formerly sold for $7.50. P. A. Products special only $2.98.

Here's your chance

Some rare bargains now available to readers of POPULAR AVIATION. Quality merchandise exclusively—sold with the absolute guarantee that your money will be immediately refunded if you are not entirely satisfied. Most of these bargains were picked up at auction and are offered at a fraction of the original cost.

FLYING SUITS

Special white canvas suit endorsed by many airport mechanics. Special 2 breast pockets and side pockets. A real overall. Only $3.98.

AERO SPARK PLUGS

Try a RAJAH spark plug in your plane or car. These Rajah airplane spark plugs are of the metric thread 18 millimeter which fits so many modern cars such as Cadillac, La Salle, Auburn, Plymouth, Chrysler, Dodge, Hupmobile, Nash, Oldsmobile, Model 1 Packard, Model 1 Pierce Arrow, etc. These spark plugs are of the open end type and were picked up at auction. Formerly the property of U. S. Navy. The porcelain is removable and the electrodes made of highly resistant special analysis steel which gives a hot juicy spark. Now is your chance to get more power and to save on fuel. Use airplane spark plugs A real bargain. 6 for $1—12 for $1.80.

Regulation Aviator HELMET

This leather helmet is a favorite among all aviators. Can be obtained in either white, brown or black. Fits snugly around neck and forehead. Price $2.39.

NAVY HELMET

(Extra Heavy)

These helmets were made for the U. S. Navy by Alexander Taylor and Spaldings to Navy specifications. The outer shell is made of selected soft brown calf leather. The inner lining is of Grade A chamois and the inter-lining of electrified nutria fur. All the seams are doubled and turned in. The chin piece has an extra fur lining to protect the chin from chafing. 2 leather goggle straps are provided on the back with snap buttons. Only sizes 7¾ and 8 are available, large enough to permit the wrapping of a parachute silk scarf around the head as a further protection against cold. This is the headgear that has been often seen around naval air stations. We have a supply of these helmets obtained from a naval auction sale. Original cost $6.00. Our price while they last is only $2.95.

PARACHUTE SILK SCARF 60" BY 18"

Favorite among aviators, sportsmen. Made from genuine parachute silk. 60" long and 18" wide. This is the latest in scarfs—use it for dress wear as well as for keeping neck and chest warm during flight. Special price while they last, only $1.95. **Log book free.**

Above prices include packing and shipping costs. Send cash, check or P. O. money order with order. C. O. D. orders shipped at slight extra charge.

AVIATION PRODUCTS
619 SOUTH FEDERAL STREET • CHICAGO, ILL.

SUPREME STOCK
FAST SERVICE
REASONABLE PRICES

THE BEST MODEL BUILDERS DEMAND THIS KIND OF SERVICE

BALSA STRIPS 24" Lengths

1/16" sq.....5 for .01
1/16"x⅛".....4 for .01
1/16"x3/16"....3 for .01
1/16"x¼".....3 for .01
3/32" sq.....3 for .01
⅛" sq.....2 for .01
3/32"x3/16"....2 for .01
⅛"x¼".....each .01
3/16" sq.....each .01
¼" sq.....each .01
⅛"x⅜".....each .02
¼"x½".....each .03
½" sq.....each .05

BALSA SHEETS 24" Lengths

1/32"x2".....each .03
1/16"x2".....each .03
1/16"x3".....each .07
1/16x4".....each .11
3/32"x2".....each .05
⅛"x2".....each .05
3/16"x2".....each .08
¼"x2".....each .08
¼"x3".....each .15
½"x4".....each .20

BALSA PLANKS 24" Lengths

1"x1".....each .10
1"x3".....each .25
2"x3".....each .48
2"x6".....each .60

BALSA PROPELLER BLOCKS

⅛"x⅜"x6".....each .01
½"x⅜"x6".....each .01
9/16"x⅞"x7"....each .03
¾"x1¼"x8".....each .04
⅞"x1¼"x8".....each .05
⅜"x1½"x10".....each .07
1"x1½"x8".....each .08
1"x1½"x10".....each .10
1"x1½"x12".....each .12
2"x2"x12".....each .22

ALUMINUM SHEET

4"x6".....each .05

BAMBOO

Shred (1/32"x1/16"x-12").....2 for .01
Split (1/16"x¼"x-12").....each .01

BANANA LIQUID

1 ounce..... .10
2 ounce..... .15

BEARING BUTTONS

13/64"x¼".....each .05

CELLULOID SHEET

4"x5".....each .03

CEMENT

Large tube.....each .05
Jumbo tube.....each .10

DOPES (Colored)

White, black, brown, green, drab, orange, red, yellow, blue, silver, gold, khaki, 1 ounce..... .10

GLOSS DOPE

Produces shiny surface. 1 oz... .10 2 oz... .15

SILK (Extra Fine)

Per square yard..... .75

INSIGNIAS

A complete set..... .05

MOTORS (Celluloid)

1½".....each .25
2".....each .35
3".....each .45

CYLINDERS

Celluloid.....each .04

FIBRE

.025"x3"x9".....each .08

KNIFE

For propeller carving.....each .60

PAPER (Japanese Tissue)

White, blue, red, orange, khaki, black, yellow, green. 20"x24".....each .05 18"x24" white superfine..... .08

PROPELLERS (Machine Cut)

5"..... .05 6"..... .06
7"..... .07 8"..... .08

PROPELLER SHAFTS

Each..... .01

REED

1/16"x36".....each .03
⅛"x36".....each .05

RUBBER STRAND

1/32"x1/16".....3 ft. .01
1/32"x⅛".....3 ft. .01

THINNER (For Dopes)

1 ounce..... .10

THRUST BEARING

For stick models.each .03

TUBING (Aluminum)

1/16"x6".....each .05
3/32"x6".....each .05
⅛"x6".....each .06
3/16"x6".....each .07

TUBING (Rubber)

Flexible, ⅛"x12". ea. 05,

WASHERS (Brass)

5/32" O.D...per doz. .03

WIRE (Aluminum)

5 ft. coil..... .03

WIRE (Music)

Straight lengths—24", Nos. 6, 8, 10, 12 and 14.....each .02

WHEELS (Aluminum)

⅜" dia.....pair .08
1⅜" dia.....pair .15

WHEELS (Balsa Balloon)

¾" dia.....pair .04
1" dia.....pair .05
1⅜" dia.....pair .06
2" dia.....pair .10

WHEELS (Celluloid)

⅜" dia.....pair .10
1" dia.....pair .10
1 3/16" dia.....pair .12
1⅜" dia.....pair .15
1⅞" dia.....pair .25
3" dia.....pair .35

WHEELS (Hardwood)

⅜" dia.....pair .03
1" dia.....pair .05
1¾" dia.....pair .10

3/4 Scale Plans-50c ea.

Bristol Fighter	Span 29"
British R.E. 8	Span 32"
Sopwith "Pup"	Span 19¾"
British S.E. 5	Span 20"
deHaviland "5"	Span 19½"
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Airmail

(Continued from page 290)

We know what it means to all of us if he stays. A crash on a desolate mountain and death from injuries or the freezing cold night. In our eyes Bruger becomes a hero, ready to sacrifice his life to save ours and Jaxon's, with a slim hope the mail will reach its destination.

Come on, my POPULAR AVIATION reader-friend. The situation is so desperate that we can do no less than Bruger. We agreed to fly this trip at our own risk. And we can lessen the weight of the ship enough to make our absence count. Give Jaxon a break. Come on. That a boy!

We join Bruger at the side door. In the grey blackness he gives us careful instructions. "Step out; clasp the ring; count three and pull!"

In silence we shake hands and holler "Happy landing!" to Jaxon. He shouts something about us sticking it out with him—that it means certain death to jump.

But already Bruger has the door open and has dropped out into the night. You go next. I follow. A cold blast of air stings our faces with a shower of leaden-like bits of steel. One . . . two . . . three. We pull our rings. Down, down we go. What awaits us below we haven't the slightest idea. We dare not guess.

We wait an eternity. Why doesn't the 'chute crack open and stop this maddening, terrifying, speedy descent? We wait only a few seconds that seem like agonizing hours. Suddenly there is a terrific jerk at our armpits. The harness seems to grab us up out of our fall. We hang in space. We have cracked silk! Human pendulums, slashed and pushed by the screaming wind, we sway back and forth. All is blackness around us. Blackness filled with sleet that stings our faces like a steady shower of nail heads.

The storm is worse than we thought. People who walk about on earth can never have the understanding of the terrors of a storm to one dropping in a 'chute—fighting to save his life.

Above the screaming of the night we hear the thunder of Jaxon's engines. They grow fainter; become a purr and then . . . Good God!—be merciful to Jaxon. Above the hideous shrieking of the wind we distinctly heard a crackling, ripping, tearing sound, followed by a sickening, heart-rending crash. A thunderous crashing sound as if Rattlesnake Mountain had suddenly transformed itself into a volcano and violently erupted.

We know the horrible meaning of that sound. Hell's Stretch has been aptly named—the graveyard of aviation. Jaxon didn't make it. The old crate had crashed.

But we must turn our thoughts to ourselves. How fast are we dropping? What is beneath us—a bare mountain or one covered with trees that are always dangerous to parachutes? A railroad track, a river—what? We have absolutely no way of knowing what awaits us.

Looking down we gasp, half-startled, bewildered. The darkness beneath us has suddenly exploded into a dazzling, blinding whiteness. When our eyes become accustomed to this strange light we can see pellets of sleet driving, swirling down beneath us. We can even see shimmers of light reflected off the ice that has already frozen to our clumsy winter flying moccasins and up the legs of our fur-lined flying suits.

That light. It means Bruger, some place beneath us, released a Very flare. Its several millions of candlepower illuminates the swirling territory for nearly a half mile.

There he is! See his 'chute, like a big mushroom, over to the right about 300 feet. Look! His 'chute fouls on an extending branch of a tree at the beginning of a wooded spot. For a moment he dangles in space. Oh! The 'chute has been ripped. It's tearing under his weight. He drops to the ground and lies still.

Slip your 'chute. Hurry! Pull on the risers. Work away from the woods. Pull hard. The ground is just beneath

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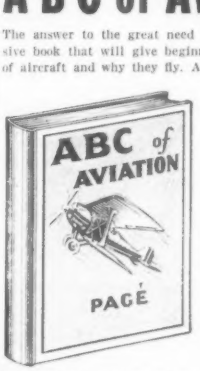

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you. Bend your knees to absorb as much of the shock as possible. You're down. Look out! The wind has bellowed your 'chute. You will be dragged over the ground.

Quick! Pull in the underside risers. That's the way to flatten your 'chute. This is one of the most hazardous moments of anyone parachuting. You're in for a nasty experience. You'll be lucky if you get out with only a misplaced nose, a sprained ankle, or a dislocated shoulder. Good work! You hauled her in like a veteran and the old 'chute is too flat to cause you any worry now. Get out of your harness and be ready to help me.

I have more trouble than you. I'm being dragged over the jagged ice. Help me pull the risers. There, I'm out of my harness. Carry the 'chutes? Hell no! Not through this ice-crusted snow. It must be nearly two feet deep.

Quick, let's get over to Bruger. There under the tree. How cold and still he looks. It's a good thing that Very light is still burning.

Boy, what a relief. Bruger is not hurt, just shaken up a bit. He says sadly:

"Well, we bailed out safely. But it didn't help Jaxon. Did you hear him crash? We've got to find him."

We wonder how Bruger thinks he can do it. It's pitch dark; the screaming wind hurls sleet against us, stinging our faces. It's cold—bitter cold. But we follow the brave co-pilot. We can guess what thoughts are troubling him—Jaxon may be seriously injured—if he is still alive. And the mail must be recovered.

When a cold bleak dawn breaks through the blackness of the night we find ourselves in a small mountain valley. Scanning the side of the ice-covered Rattlesnake Mountain we see, some distance away, a jumbled mass of wreckage.

The crashed ship!

But we see no signs of life. Jaxon must have been killed.

"Looks to me the ship isn't burned," Bruger clips. "Thank God, Jaxon kept his head and shut off the ignition. There is still hope he may be alive. Hurry!"

HOURS seem to lag as we flounder through the snow. Our faces are numb; our fingers have no feeling. But on we go. We approach the wreckage with pounding hearts. Dreading to look inside the twisted and torn cabin for fear we might see Jaxon's mangled body, we follow Bruger. He climbs over a twisted tail assembly, reaches the pilot's place and looks in. The ship is empty. Jaxon is nowhere in sight.

We speculate on where he might be as we pull the mail sacks from the wreckage. Bruger cleverly makes a sled out of a piece of metal. Control cables are tied to it and we are elected to help pull the mail down the mountainside.

We grow rigid and listen. What was that sound we heard above the wind? Was the storm playing tricks with us; are our minds cracking from the strain we have gone through? There it is again! It's a man's voice. He's calling, "Bruger!" Can it be? . . . Yes . . . it is . . . ! See him over in that sheltering ledge of rock?

Wildly, happily we race through the snow to Jaxon.

"The ice piled up too fast after you fellows bailed out," Jaxon explains. "I couldn't make the hump. I put her into a stall and bailed out." He groans. "My ankle . . . just a little sprain."

We examine his ankle. It's broken.

It takes time to get Jaxon over to the mail sled. We pack him in with mail sacks all around him to help keep off the biting wind. Then you and I, with Bruger, pull the improvised sled down the mountainside.

Hours later the mail is aboard a train and on its way.

The mail got through. But Jaxon did not. He will spend a little time in a hospital. And Bruger's company ordered him to stay and keep his flying partner company.

As for you and I—we are on our own again, happy that we made the flight and proud to know two stout-hearted pilots of the air mail like Jaxon and Bruger.

END

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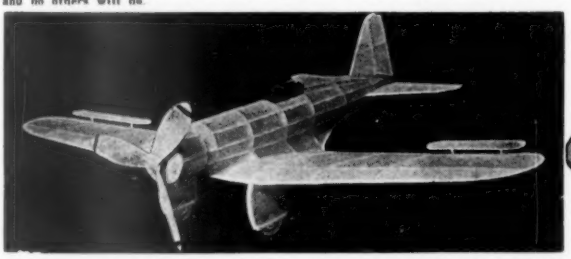

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(Continued from page 312)

Molybdenum or S.A.E. 4130 tubing is used, but this does not always work out, so do not use any other steel than that shown on the details. Another thing to watch is that all tubes are cut and fit to the lengths shown, otherwise the fuselage will not line up as it should.

At the factory, the fuselage are cut, fitted and welded in a steel jig, but building a steel jig for welding up one fuselage would be out of the question. The cost of such a jig runs considerably higher than the fuselage itself, so it will be necessary to use a temporary jig which will be discarded a little later.

Before you start to cut up the tubing, I would suggest that you study over the details of the plans carefully, noting the quantity of each size and gauge tube needed. You will note that most of the tubes are .035 or 20 gauge. You will also note all dimensions are taken from center-lines of the tubes.

For instance, looking at the side-view of the fuselage, the dimensions given for the upright members are from the center-line of the lower longeron to the center-line of the top longeron. Therefore, care should be taken to make proper allowances when cutting the tubes to insure the right length. The ends of the tubes are cut and filed to a close fit to the tube it joins.

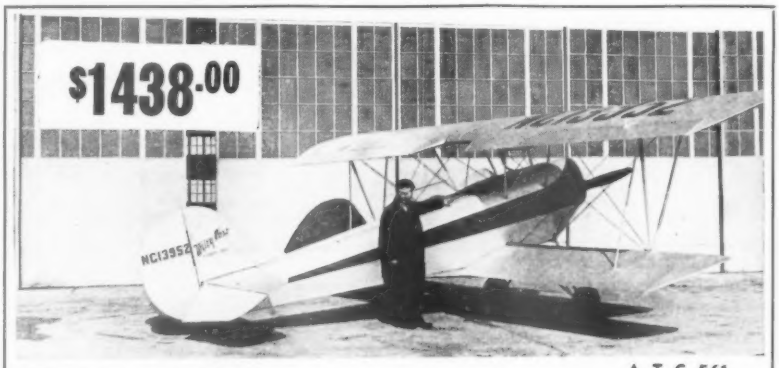
When you are ready to start work on the fuselage, a full-size layout should be made on the floor or wood bench for the side of the fuselage, this will be like the side-view shown on the drawing. Nail small blocks along this layout so as to hold the tubing in place while cutting and fitting the tubes. Nail blocks on each side of the tubes and when all tubes are fitted, for one side of the fuselage, they should be tack-welded into their places. The motor mount is not considered in making up the sides, so assemble the side up to station No. 1. The motor mount will be added after the sides are put together.

After the first side is completely tack-welded, lift the side from the jig and build up another one in the same manner as the first. When the two sides are finished, cut all of the cross-tubes and set the two sides upright, letting the top longeron rest flat along the floor or bench. Now tack-weld the cross-pieces in place along the bottom longerons, the braces are next tacked along the top longeron as detailed.

The longerons are next tacked at the rear and the tail-post tacked in place. With this completed, find and make a mark along the centers of all cross-braces both top and bottom. Stretch a string from the front station to the tail post. This is used to line up the fuselage for the cross-braces along the top and bottom of the fuselage.

Be sure the string crosses all the center-marks before fitting and tacking the tubes in place. A large square should also be used to insure that each station is square. For you who have built model planes, you will find the assembling of a large fuselage very much the same as that of a model. After all the tubes are in place along the top and bottom of the structure, the torque tubes are fitted and tacked in place. These are shown in the front views of each station at the lower right hand corner of the drawing.

When all of the braces are tacked in place, the fuselage should line up and the sides square with the top and bottom. After you are sure everything is lined up, you may start the weld-



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ing. Weld each joint complete. It is a good plan to start the welding at the tail post and work forward for when the heat of the welding torch is applied the tubing has a tendency to expand and warp the fuselage.

After the welding of all joints has been finished, the cabane and the wing-strut attachment fittings are tacked in place and lined up. After this, they may be welded as detailed and the gussets welded on. The landing-gear fittings are next welded onto the bottom longerons as detailed. You will note that these fittings are made up of two small tubes, one welded on top of the other and then welded to the fuselage at the angle shown.

The gusset is then welded around the fittings as per details. The rest of the fittings are clearly shown on the plans so I do not think it necessary to spend much time on these details, but do suggest that care must be taken to align all fittings as they should be.

The motor mount is now welded to the fuselage as detailed and it must be remembered it is necessary that the motor mount be in perfect alignment with the fuselage so that the line of thrust be parallel to the line of the top longerons, otherwise the ship will have a tendency to fly nose-heavy, tail-heavy or from one side to another and will prove anything but stable. Note the gussets that are used at the joints of the mount. These, of course, are welded on after the tubing has been completely welded. Do not leave these gussets off.

When you are welding the motor attachment lugs to the motor bearers, it will be a good idea to set your motor block in place so the lugs will line up according to the bolt-holes on the motor which are used for bolting the motor in place.

After the fuselage is completed it should be painted with rust-proof paint. Silver bronze paint is very good for this work and will make a very nice looking job. However, red lead can be used. Oil paint should not be used for the dope used on the fabric will act as a paint remover and your fuselage will rust out in places where paint has been removed owing to the fact that tubing is made of very light gauge steel and extreme care should be taken to prevent rust as just a small amount of rust will weaken the tubing.

END

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(Continued from page 282)

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And yet—there have been daily rumors of dissatisfaction with these arrangements in Japan and protests by that nation against the establishment of airways which, to her mind, might possibly become militaristic on short notice. This, however, is believed to be nothing more than a momentary reflex against a drastic innovation by the United States which, in the long run will work out to Japan's profit and satisfaction, as well as to the profit of other Asiatic nations.

It is to be believed that Japan's attitude is simply one of precaution and not of suspicion.

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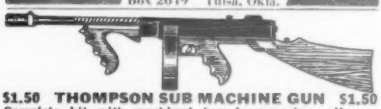

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Dept. A
641 McDonald Ave., Kensington Sta., Brooklyn, N.Y.

Aero-Sportswoman

(Continued from page 306)

ing such a column as this, is the letters one receives. The day is much brighter when you open a gay epistle, such as the one we had from Gayle Christensen, Pocatello, Idaho, that has a tiny sketch of an airplane zooming across one corner and a parachute billowing out below. Gayle starts out by saying, "May I take this opportunity to bail-out and give you my opinion of P.A. and the Aero-Sportswoman?" The said opinions were very complimentary and duly appreciated!

Miss Christensen, who is the public school nurse in Bannock county and a student pilot, made a parachute jump in an air carnival held in Pocatello last summer. "It was my first jump" she writes, "and as far as I can find out the first woman's jump in the state. Our plans when first started were just to wear the chutes and then throw out a dummy to thrill the crowd, but I decided that I would rather play the part. So, the 'dummy' supported by two chutes made a happy 'pancake' landing."

Miss Christensen said that she had applied for a position as a stewardess on the United Airlines . . . "for there seems to be a stronger interest in sailing the blue, than in inspecting school children." And that brings us to the old, old question of *how, when* and *where* one gets such a job! We thought we had answered it once and forever, in a lengthy article on the subject in the May, 1933, issue of P.A. It is true there are a good many more air hostess positions now than there were two years ago, but as far as we know the requirements are the same as outlined to us by E. P. Lott, vice president of NAT, at that time.

"The necessary qualifications are few," he said, "but it is far more difficult than you think to find them combined in one girl. The essential requirements can be boiled down to just four points. She must be a registered nurse, have an attractive personality, be good looking and *intelligent!*" He stressed the fact that they would not consider anyone but a graduate nurse, which is of course the chief barrier to many girls who aspire to such a position.

The only line that did not make this requirement was Eastern Air Transport, but they only employed a few girls and had literally thousands of applications on file for every position. We hope that answers the questions for Virginia Stoddard, Columbia, South Carolina; Polly Abbott, Hattiesburg, Miss.; and Gertrude Emery of Flint, Michigan.

Another question that has been asked several times . . . is where can one order the magazine, AIRWOMAN, which is published by the 99s and W.N.A.A.? It may be secured through Clara Studer, Hotel Gotham, 55th and Fifth Avenue, New York . . . ten cents a copy, or one dollar a year. You are welcome for the information, Carolyn Randon of Yorktown, Texas; E. O'D of Grand Forks, North Dakota; and we especially recommend it to Dorothy Ring, Woodhaven, New York, to help her to keep up on her "Current Events in Aviation."

Lucille Beckwith of Brightwood, D. C., suggests that the AERO-SPORTSWOMAN promote a model-building contest for girls, similar to the various ones that P.A. has sponsored for the boys. We seem to remember that Phoebe Omlie of the Department of Commerce made somewhat the same suggestion to us last summer. How about it, girls, would there be enough interest to make it worth while?

Little Emilie Folkhsh, Milwaukee, Wis., wants us to start a regular section called "Pen-pals," wherein letters would be published. "Then people could correspond together, that would make it more interesting," and as she ingeniously explained "the people would buy more magazines, because they would want to see if their letters are printed."

And from San Diego, California, Albertine Fox writes to say that "POPULAR AVIATION is the best aviation magazine on the market." Then she proceeds to comment, briefly, pithily and gayly on the various departments, and says she, "I want to send on a cheer or two for that swell writer, Joan Thomas, for her *extra* swell column in the AERO-SPORTSWOMAN." We have been all puffed up over that, Albertine, even if we haven't had time to write and tell you so . . . but let us hear from you again.

END

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Gasoline

(Continued from page 296)

small bits, as it were, and then rebuilding them into fuels of high anti-knock value—or, in other words, by synthesis. The breaking down process occurs today, he points out, accompanying every cracking operation, so well-known in petroleum refining. A portion of the oil is broken down into gaseous material, containing one, two, three or four atoms of carbon per molecule. It is here that he believes we may find the starting point for the aircraft fuel of the future.

"Given our small molecule, and assuming that we can build it up in various ways, what chemical type of fuel do we wish to form from it?

"Three classes of hydrocarbons are known which possess extremely high anti-knock value. These are (1) condensed or branched chain paraffins. Iso-octane is an example of this class and others are known of even higher anti-knock value; (2) branched chain olefins, of which di-isobutylene is an example; and (3) certain aromatic hydrocarbons, preferably more complex than benzene itself. Of these classes, it would appear that for high performance aircraft fuel, the condensed paraffins offer the greatest possibilities, as they retain their high anti-knock value under almost all conditions; they are chemically stable and they have the highest heat of combustion per pound."

It is generally pointed out by those who have made a study intensively into this situation, and verified by Dr. Edgar's findings, that both the branches chain olefins and the aromatics have the disadvantage that their anti-knock value varies greatly with the conditions of test. The olefins are relatively unstable chemically and suggest the possibility of poor storage characteristics, although it is not known that this is important. It is known, however, that the aromatic hydrocarbons have the lowest heat combustion per pound. A further disadvantage of this class is that in some instances they have also an undesirable high freezing point.

It may be suggested that besides the hydrocarbon fuels there is the possibility of synthesizing oxygenated compounds such as alcohols, which possess various structures. While not a great deal is known of the advantages of these products as aircraft fuels, it is known that they have considerably less heat of combustion per pound than the hydrocarbons.

"At the present time," states Dr. Edgar, "more is known about the synthesis and full-scale engine use of iso-octane than of any of the other fuels suggested. It has been eight years since our own laboratory first described the high anti-knock value of this material and proposed its use as a primary standard for anti-knock determinations. Within the last two years, substantial quantities of it have been prepared in reasonable purity by more than one oil refiner, starting with the isobutylene of refinery gases.

"It should be pointed out that, of necessity, synthetic fuels will be substantially more expensive than those produced by simple distillation methods. They will therefore only come into wide commercial use if their advantages in the way of power production possibilities are great enough to outweigh their extra cost. In the interest of economy, it is probable that any such fuel will be used as a blending agent, being blended with the best gasoline available, and also probably with conventional anti-knock agents, rather than in the pure state.

"One important fact to remember is, and this fact is not always recognized by the air transport operator, that fuel cost should be estimated on a 'cost per ton of pay-load basis,' rather than a 'cost per gallon' basis. If fuel of extremely high anti-knock value permits a sufficient power increase, the cost per ton-mile of pay-load may be lower even if the cost per gallon is doubled. Recognition of this principle by airline operators will do much to further the development of better fuels."

It may be stated here that three general classes of aviation motor fuels are now available, having octane numbers of 73, 80 and 87. It is asserted that the proportion of 87 octane, which is in regular production, is increasing in relation to that of the other two. The increased call is coming largely from heavy duty transport units. What is known as 87 octane fuel ordinarily is classed as a 92 number.

That aviation motor fuel requirements are causing oil refiners and marketers to think along more aviation-minded channels regarding the needs of their domestic motor fuels for use in automobile engines is noted in the fact that several large refining and marketing companies recently have brought out "premium aviation" gasolines for their best service station trade. These are special products, with low initial boiling points, low intermediate boiling points and relatively low end points.

END

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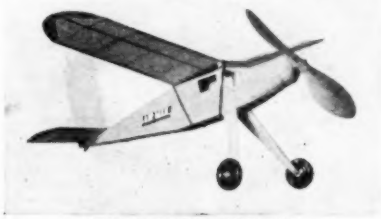

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HAVE workshop band saw and lathe. Would like model gas engine or what have you?—Walter Bray, 445 W. Front St., Logan, Ohio.

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WANT—Washing machine, bicycle, motors, any make, condition, parts. Magnetos for Smith motor-wheel, 24"x4"-700"x4" wheels, tires. .031 oversize aluminum pistons, high lift camshaft for Ford "T", trade, cash. TRADE OR SELL

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Blue Bird

(Continued from page 290)

and dural connecting rods make for a sturdy power plant that will adequately handle the plane. Empty weight of the ship is 452 lbs., disposable weight, 448 lbs., and the gross weight, 900 lbs., which puts its power loading at 25.7 lbs. per horsepower. The wing loading is 5.14 lbs. per square foot.

It has an overall length of 19 feet 3 inches, an overall span of 36 feet 3¼ inches and an overall height of 7 feet 11 inches. The chord is 59 inches, airfoil section, C-72, angle of incidence, one degree and dihedral, two degrees.

The wing area is 175 sq. ft., aileron area, 22.60 sq. ft., stabilizer area, 11.67 sq. ft.. elevator area, 8.68 sq. ft., fin area, 6.58 sq. ft., and rudder area, 7.51 sq. ft. Top speed is rated at 85 m.p.h., and stalling speed at 35 m.p.h.

The *Blue Bird* is a design by A. B. Green, who has been most actively engaged in aviation pursuits since Wilbur and Orville Wright first startled the world by sailing through the air at Kitty Hawk. Quite appropriately, with the pioneers of the air industry, Mr. Green began his career with a balloon ascension and as early as 1910 constructed a dirigible at Omaha, Nebraska.

During the war he was an experimental flier and more recently has built planes commercially in a number of places, notably in Kansas City and California, where he put on the market a passenger cabin job with an open pilot cockpit at the rear of the cabin. His experience, plus his originality, has produced a little ship that is well worthy the attention of aero fans.

The lightweight ship idea, involving both low cost and safety, has been a pet of his for a number of years, Mr. Green said in an interview. His first experiments were unsuccessful as he attempted to produce an all-metal job.

"Then I decided to do away with the conventional, lengthy fuselage," he said, "and in its place use a beam construction (illustrated in the accompanying photograph). Likewise, I built an abbreviated 'teardrop' body and placed the center of gravity in the center of the plane. It had all the desired stability and safety in handling a lightweight ship required and met my most rigid tests.

"I am still flying my personal ship. It has 3,000 flying hours behind it, has covered 250,000 miles and when I recently had it relicensed by the Bureau of Air Commerce, I found it unnecessary to expend a cent for repairs in order to meet the test requirements." The *Blue Bird* is being manufactured under a department of commerce license. As much care is put into its construction, the builders aver, as into ships of many times the price. Zippered inspection flaps are built in for easy access to cable fair-leads and pulleys.

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Spar material, ⅞"x1"x6" wide, per ft.	.11
1/16" or 3/32" birch, up to 36"x72", per sq. ft.	.10
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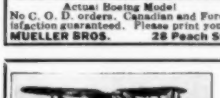

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License

(Continued from page 294)

the inspector or ask fool questions for his estimate of you will be lowered if you do. Telling him how good you are is about the worst thing you can do, because it indicates you are a Smart Aleck and there is no room in the flying game for a Smart Aleck.

If you are turned down, don't act as if the world depended on your getting that license. Try again. If you had done a half-way decent job of flying or writing the examination you wouldn't have been turned down, so don't blame it all on the inspector. Remember, his job is a hard one, and that he is not an ogre taking a fiendish delight in depriving you of your license. You failed to convince him of your ability so resolve to do better next time.

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Spinning

(Continued from page 292)

movement is limited to that necessary to give adequate control in landing.

Spin tests must be made for the extreme forward position of the C.G. and the most rearward position. The rearward C.G. position is usually critical, so it is advisable to start the initial spin tests with the loading such as to give the most forward C.G. position, going on to the tests for rear C.G. position when the other tests have proven satisfactory.

If the above suggestions are followed and reasonable care exercised, it should be possible to spin test any airplane without undue hazard. The procedure on flight testing and spinning may be applied to any conventional type airplane as well as low-wing monoplanes.

On the writer's airplane, no uncontrollable spins were obtained but the initial tests resulted in some flat spins. The worst of these took 5 turns for recovery from a six-turn spin. The airplane would begin to go flat with about the fourth turn. To correct this, a larger rudder and fin and a larger stabilizer were installed. These changes helped giving better control, slowing down the rate of spinning, and causing the airplane to maintain a more normal attitude.

A bad spin could then be obtained only when the ship was thrown in very violently. The C.G. was then moved forward by putting weight in the nose. This also improved the longitudinal stability which was marginal. A point was reached where the airplane spun perfectly, recovering from a six-turn spin in one-half a turn with controls in neutral and engine idling.

The weight was then removed and the engine moved forward to give a C.G. position somewhat ahead of that obtained with the weight in the nose so as to be well on the safe side, even with the worst possible loading conditions. The airplane then passed its flight tests with the Dept. of Commerce.

The final position of the C.G. was 28 percent of the Mean Aerodynamic Chord. The vertical C.G. position in this airplane was about even with the top surface of the wing at the M.A.C. due to keeping the weights low and giving the wings 5 degrees dihedral, so it was unnecessary to put the C.G. very far forward of the H.A.A. center of pressure position.

A farther forward location was not desired because of the heavy down load on the tail that would be required to balance the airplane in level flight and the greater amount of elevator control that would be required to get the tail down in landing.

The following table gives the areas of the individual tail surfaces on this airplane and their percentage of wing area:

	Wing Area 149 sq. ft.	Percent Wing Area
Stabilizer	18 sq. ft.	12.2
Elevators	9.4 sq. ft.	6.3
Fin	5.3 sq. ft.	3.5
Rudder	7.3 sq. ft.	4.9

I found the Dept. of Commerce inspectors to be critical but fair; fine pilots who know their business. They insist on a high standard of design, workmanship and flying qualities, but are ready to pass any airplane that conforms with their requirements.

And they are particularly strict, as they should be, on the matter of spinning characteristics during the flight tests. Their care in this respect is undoubtedly the reason for many rejections and the cause for the resulting complaints of the designers and builders against the Department inspectors. But I feel assured that given a new plane that performs within the spirit and letter of the regulations, that the builder will get fair and courteous treatment by the Department.

In general it is the writer's belief that the low-wing monoplane can be made the best all-around airplane of the group and that its design and flight testing offer no greater difficulties than those found in other types, if the fundamental problems incident to the low-wing monoplane are clearly understood.

END

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